Ⅱ ĂdžƧŏ!ƒ ƗzdžĜη
ƗŏbƧk!ƒ Ɨŏǁǂ
Σ ŏƧϸk!ƒĂ ЛNjĜǀdž!ƒ Džʅp

DžƐNjǆƴĜ ǁƐϸNjƗ!ɋ ʜΘNjϸƯć

أثر المختبر الإفتراضي في إكتساب المفاهيم الهندسية ومهارات التفكير الناقد والمهارات العملية لدى طلبة الهندسة الإلكترونية في جامعة اليرموك

The Effect of Virtual Lab in Acquiring Engineering Concepts, Critical Thinking Skills and Practical Skills of the Electronic Engineering Students at Yarmouk University

ɋƐɋƳɗ

عمر علي الحواري

ϸNjƗǀɋǁƐ ǷƗƨǛƐ ƹƐϸʅɗ

غازي ضيف الله رواقه

ƑNJƨǐϸɋƗ ƒǐǁƑƨďNj !NjǂƴǁƐ ƛljƑǆĎž : ʈ ƬɊƗǁƐ üsΘ

! 2014

أثر المختبر الإفتراضي في إكتساب المفاهيم الهندسية ومهارات التفكير الناقد والمهارات العملية لدى طلبة الهندسة الإلكترونية في جامعة اليرموك

إعداد

عمر علي الحواري

بكالوريوس هندسة كهربائية/إلكترونيات وإتصالات، جامعة العلوم والتكنولوجيا، ١٩٨٩

ماجستير هندسة الأتمتة الصناعية، جامعة اليرموك، ٢٠١٠

قدمت هذه الأطروحة إستكمالاً لمتطلبات الحصول على درجة الدكتوراه في الفلسفة تخصص مناهج العلوم وأساليب تدريسها في جامعة اليرموك، إربد، الأردن

وافق عليها

أ.د. غازي ضيف الله رواقه (المشرف)..رئيساً

أستاذ في مناهج التربية المهنية وأساليب تدريسها في جامعة اليرموك

أ.د. إبراهيم فيصل رواشده..عضواً

أستاذ في مناهج العلوم وأساليب تدريسها في جامعة اليرموك

أ.د. علي مقبل العليمات...عضواً

أستاذ في مناهج العلوم وأساليب تدريسها في جامعة آل البيت

أ.د. عدنان محمد خير الصمادي..عضواً

أستاذ في الهندسة الإلكترونية في جامعة اليرموك

د. محمود حسن بني خلف..عضواً

أستاذ مشارك في مناهج العلوم وأساليب تدريسها في جامعة اليرموك

الإهداء

حقاً.... تعجزُ الكلمات أن تخص بإهداء هذا الجهد المتواضع أناساً بعينهم فهم كثيرون... ساندوني

في كل رحلتي العلمية وتعبوا معي إلى أن أنجزت

اطروحتي هذه..........

أهديها إلى... **أبي** ... رحمه الله... **وأمي**.......... أطال الله عمرها... اللذان كانا ومنذ صغري يُضيئان

كل الشموع في دربي.... فلا أجدُ نفسي إلا أن أكون مُقصراً في حقهما علي، لأن حُبهما يسطعُ في قلبي

دائماً فهما الشمسُ والقمرُ اللذان

يُضيئان حياتي...

إلى رفيقة دربي ومن كابدت العناء معي وقدمت لي المحبة والحنان..

زوجتي حنان...

إلى فلذة قلبي.. أبنائي... وبناتي...

هشام وكرم ... راما ولين

الى الأُستاذ الدكتور **إبراهيم القاعود** الذي ساندني وقدم لي كل العون

وإلى **أقاربي وأُصدقائي**.. وكل من قدم لي المساعدة...

إليهم جميعاً أهدي هذا الجهد المتواضع.

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[illegible]

üƑ׀ƪǙƸ ƜƊǎǝƑƼ

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[illegible] .([illegible]) 2014

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[illegible] (88) [illegible] (1) [illegible] (44) [illegible] (Circuit Maker) [illegible] (44) [illegible]

[illegible]

[illegible]

الفصل الأول

خلفية الدراسة

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(2004) ... (2008)

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[illegible]

[illegible] .(245 :2003 [illegible])

[illegible]

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[illegible]

ƘơƅƮƉ ƒƦǌƅĂ ÜƩőƧƥƙ!ƒ Ŏ5 ƖƠǂƠơƊǆ!ƒ ƘƠƊǆƒƥƤƙƪƒĂ ƘƠƺ! Ƙƥƥƶƙ ǂőơ ÜǂƼƙƤƊǆ!ƒ ƔőƪƒĂơ!ƒ ƧĂƱƙ

ǂƶƙƊǆ!ƒĂ ƱƠƮǉ!ƒ ƠǌőƶƵ Ĭ5ưƉ ƠǆƊ ƒƦǋĂ ÜǂőƥƠƊǆ!ƒ ǉƧƠƪƤ!ƒ ǇƊǆ ýőƙ!ƠƅĂ ǂǉĂƧƊǆ!ƒĂ ǂőĂőơ!Ơƅ ƨƠƙƊǆƙ

Ý2010 ÜŸƒ ƧƮǉ) ǂƅƶƮ!ƒ ǂőƊǆƶ!ƒ ƥƒĂƊǆ!ƒĂ ƘƒƧƠǌƊǆ!ƒ ƯƶƅǃƊǆőƶƙ!ƒ ǇőƪơƙŎ5 ǂőƵƠ5!ƒĂ

.(2000 ÜƱĂ5ơƊǆ

ǂőƊǆőƶƙ!ƒ ǂőƊǆƶ!ƒ ƧƠƪƊǆ Ŏ5 ƖĂƅ ƘƊǆǌƪƉ Ŏƙ!ƒ ƖƧƮƠƶƊǆ!ƒ ƘƒƧƛƊǆ!ƒ ǇƊǆ ƧőƛǂƧǌƱ

ƖƠǂƠơƊǆ!ƒ ƊǆƒƥƤƙƪƒ ǂőƊǆǋƉ Ĭ!ƍ ĂƵƥƙ Ŏƙ!ƒ ƘƠƅƱƙƊǆ!ƒ ǇƊǆ ƥőƥƶ! ƘƥƉ Ŏƙ!ƒĂ ƠǌƅőƠƪƉĂ ƠǋƒĂƙơƊǆĂ

ƥƥĂ Ü(2003 Üƽő5Ăƙ) ǇőƊǆƶƙƊǆ!ƒ ĬƵ ýőǌƪƙ!ƒĂ ǂőƅőƧƥƙ!ƒĂ ǂőƊǆőƶƙ!ƒ ƘŬƠƞƊǆ!ƒ Ŏ5 ǂőƅĂƪƠơ!ƒ

:ƠǌƊǆǋƉ ǇƊǆ ǇƠǂ

- ǂƼƙ!ƒ ǂőƥƠƊǆ!ƒ : ơőǂ ƊǆƙőƒƥƤƙƪƒ ƖƠǂƠơƊǆ!ƒ ǂőƅĂƪƠơ!ƒ ƠƊǆǉőơ ǇĂǂő ƦőƵǉƙ ƔƧƠƞƙ!ƒ Ŏ5 ƧƅƙƤƊǆ!ƒ

ƴƵƙƧƊǆ ǂƼƙ!ƒ ĂƉ ǇőơĂƉ ǂ!Ơơƙƪƒ ƦőƵǉƙ ƘƠƱƠƮǉ!ƒ ǂőƊǆƶ!ƒ ǂőƙőƙơ!ƒ Ŏ5 ǂ5ƧƺƮ!ƒ 2 ƊǆƠƱǉǂ

.ƯƧŰƒ ýĂơ ŎƵƠǉƮ ƧƊǆƤ ƧƠƪƊǆ ƴƅƙƙ ĂƉ ǂőƪƊǆƮ!ƒ ǂơƧǂ ƴƅƙƙ ĂƉ Ɣǂƒǂ!ƒ ǂƵĂƊǆƞƊǆ!ƒ

- ƖƧĂƱ!ƒ : ƊǆƥƤƙƪƒ ƖƠǂƠơƊǆ!ƒ ǂőƅĂƪƠơ!ƒ ƠƊǆǉőơ ƙǂĂǌƙ ƔƧƠƞƙ!ƒ ǂőƧƅƤƊǆ!Ơǂ ƖƧőƱƤ ƘŭƵƠ5ƊǆƠǂ

.ƠǌƧőƻĂ ƳƠƵƮŰƒ ƔƧƠƞƙĂ ǂƊǆƠƪ!ƒ ƘƒƨƠƺ!ƒĂ ǂőĂĂǉ!ƒ

- ƘƥĂ!ƒ ýƒƨƙƤƒ : ƊǆƥƤƙƪƒ ƖƠǂƠơƊǆ!ƒ ǂőƅĂƪƠơ!ƒ ƠƊǆǉőơ ƔƵƱƙő ƔĂưĂƊǆ!ƒ ĂƉ ƵƦĂƊǆǉ!ƒ ŎƊǆƶ!ƒ ƘƥĂ

ƘƥĂ!ƒ Ŏ5 ƘƶƥĂ ǂƒƥơƉ ĂƉ ƘƠƅǉ!ƒ ĂƊǆǉ ĂƉ ǂőƧƮƅ!ƒ ƘƠǉőƞ!ƒ ƵƦĂƊǆǉ ýƛƊǆ ýőĂƱ ǂƪƒƧƥ

.ŎưƠƊǆ!ƒ

- ƧƺƮ!ƒ : ýƛƊǆ ƵƦĂƊǆǉ ǂƪƒƧƥ! ƖƧƦ!ƒ ĂƉ ƟőƖƙ!ƒ ĂƉ ƠőƧőƙǂƅ!ƒ.

- ƔőƧƥƙ!ƒ : ǂőƪƠƶƊǆ!ƒ ǇƉ ýƊǆƠƶƙ ƔƊǆ ǂƊǆǇƉ ƊǆƵǉƉ ǂĂƪ ƲƊǆƒĂ ǂƱőƪ ĬƵ ƮƠƮ ǂƪĂƪ!ƒ Ɣĸƪ!ƒ

ǁƪƠǉƊǆ ǂƪƒƧƥĂ ÜƘƒƧƠőƪ!ƒ ƖƥƠǋƥĂ ÜƠƠưƲ!ƒ ƥƒĂƧĂ ÜǇőƧƠőƱ!ƒ ƔőƧƥƙǂ ÜƴƥƒĂ!ƒ Ŏ5 ĂǌǉƊǆ ǉƅƮƙ

.ƠƅƱŰƒ ƔőƧƥƙĂ ÜǇơ!ƒ

.(Woodfield *et al*, 2004)

(Alexiou ,

Bouras and Giannaka, 2008).

(2008)

[illegible]

[illegible] .(2008 [illegible])

[illegible]

[illegible] .(2005 [illegible])

[illegible]

:[illegible] (2006) [illegible]

[illegible] -1

[illegible]

.[illegible]

[illegible] -2

(2011)

[illegible] .(Gokhale,1996) [illegible]

[illegible] (Zorfass & Brann, [illegible] .1997)

[illegible]

[illegible]

[illegible] (1) [illegible]

- [illegible]

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[illegible]

:ƕĭŀŎɛ ƕɫəƨŬɛ ĎžƳ ƕĜƑɯŲɛ Ăǁƌ ƕƨɛƥǫǁɛ ĿƤǉ ƖȥǫǉǫȿȥÿɛǫĭǫƟŀ ƥƙǀċ üǀƪĜǸ

Circuit) Ƨɫŏďž ƘɫƧŏƪ!ƒ ŀŏďžŏǁƶƙ!ƒ ŀŏɳďžƧƕ!ƒ ĎžƒƥƤƙƪƺ Ŏƣ ƒƧƙ5Ŭƒ ƧƕƙƤďž!ƒ ƧƛƊ Ĝďž -1

ŀƶďžĜɳ Ŏ5 ŀŏǉĂƧƙɫ!Ŭƒ ŀƪƥǉǌ!ƒ ŀƕǁƱ ăƥ! ŀŏƪƥǉǌ!ƒ ĎžŏǸĜƽďž!ƒ ƔĜƪƙɫƭ Ŏ5 (Maker

ŀ!Ŭƥ!ƒ ăĂƙùùƪďž ƥǉƵ ŀùŏƑĜƮơ ŀ!Ŭƥ ƘƒƦ ƽĂƧ5 ǁĜǉǸ ƥɳĂŏ ýǸĂ Þǁ ĂďžƧŏ!ƒ

ŀǀŏƧƱ ƧƛŪ ăƨƶƙ ŀƕǁƱ!ƒ ĈŬƋǸ ăƥ! ŀŏƪƥǉǌ!ƒ ĎžŏǸĜƽďž!ƒ ƔĜƪƙɫƭ Ŏ5 (0.05 = α)

ÜƊ) ƒ ƮƤƙ!ƒĂ (ŀĜǉƒĂ ÜƧĂɫƦ) Σǉɳ!ƒĂ Ü(ŀŏƥĜŏƙƵŬƒĂ ÜŎƣ ƒƧƙ5Ŭƒ ƧƕƙƤďž!ƒ) ΣŏƧƥƙ!ƒ

ÝĜǌǈŏƕ ýƵĜƽƙ!ƒĂ (Ɣ

Circuit) Ƨɫŏďž ƘɫƧŏƪ!ƒ ŀŏďžŏǁƶƙ!ƒ ŀŏɳďžƧƕ!ƒ ĎžƒƥƤƙƪƺ Ŏƣ ƒƧƙ5Ŭƒ ƧƕƙƤďž!ƒ ƧƛƊ Ĝďž -2

ŀƶďžĜɳ Ŏ5 ŀŏǉĂƧƙɫ!Ŭƒ ŀƪƥǉǌ!ƒ ŀƕǁƱ ăƥ! ƥƿĜǉ!ƒ Ƨŏɫƽƙ!ƒ ƘƒƧĜǌďž ƔĜƪƙɫƭ Ŏ5 (Maker

ŀ!Ŭƥ!ƒ ăĂƙùùƪďž ƥǉƵ ŀùŏƑĜƮơ ŀ!Ŭƥ ƘƒƦ ƽĂƧ5 ǁĜǉǸ ƥɳĂŏ ýǸĂ Þǁ ĂďžƧŏ!ƒ

ŀǀŏƧƱ ƧƛŪ ăƨƶƙ ŀƕǁƱ!ƒ ĈŬƋǸ ăƥ! ƥƿĜǉ!ƒ Ƨŏɫƽƙ!ƒ ƘƒƧĜǌďž ƔĜƪƙɫƭ Ŏ5 (α = 0.05)

ÜƊ) ƒ ƮƤƙ!ƒĂ (ŀĜǉƒĂ ÜƧĂɫƦ) Σǉɳ!ƒĂ Ü(ŀŏƥĜŏƙƵŬƒĂ ÜŎƣ ƒƧƙ5Ŭƒ ƧƕƙƤďž!ƒ) ΣŏƧƥƙ!ƒ

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ŀƶďžĜɳ Ŏ5 ŀŏǉĂƧƙɫ!Ŭƒ ŀƪƥǉǌ!ƒ ŀƕǁƱ ăƥ! ŀŏǁďžƶ!ƒ ƘƒƧĜǌďž!ƒ ƔĜƪƙɫƭ Ŏ5 (Maker

ŀ!Ŭƥ!ƒ ăĂƙùùƪďž ƥǉƵ ŀùŏƑĜƮơ ŀ!Ŭƥ ƘƒƦ ƽĂƧ5 ǁĜǉǸ ƥɳĂŏ ýǸĂ Þǁ ĂďžƧŏ!ƒ

ŀǀŏƧƱ ƧƛŪ ăƨƶƙ ŀƕǁƱ!ƒ ĈŬƋǸ ăƥ! ŀŏǁďžƶ!ƒ ƘƒƧĜǌďž!ƒ ƔĜƪƙɫƭ Ŏ5 (α = 0.05)

ÜƊ) ƒ ƮƤƙ!ƒĂ (ŀĜǉƒĂ ÜƧĂɫƦ) Σǉɳ!ƒĂ Ü(ŀŏƥĜŏƙƵŬƒĂ ÜŎƣ ƒƧƙ5Ŭƒ ƧƕƙƤďž!ƒ) ΣŏƧƥƙ!ƒ

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Circuit)

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(2008)

[illegible]

[illegible] .(Woodfield *et al*, 2004).

[illegible]

[illegible] (2008) [illegible] (2001 [illegible]

[illegible]

[illegible]

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[illegible] (Watson & Glasser, 1964) [illegible] (2006) [illegible]

[illegible]

[illegible] (43:2001)

[illegible] (310:2003) [illegible]

[illegible] (158:2008) [illegible]

[illegible]

[illegible]

[illegible]

[illegible] (1) [illegible]

.2013/2012 [illegible]

[illegible]

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[illegible] (أ) [illegible]

[illegible] (ب) [illegible]

.([illegible]

الفصل الثاني

الإطار النظري و الدراسات السابقة

[illegible]

[illegible] (1988 [illegible]).

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[illegible]

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[illegible] (1995) [illegible] (2007) [illegible]

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[illegible]

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[illegible] .(Huitt, 1998)

Halpern, 1996)

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[illegible]

[illegible] (45:2000) [illegible]

[illegible]

ШǴƙơŏĂ Ü"ƧďŬƒ ǈďž ƨ lơƙ!ƒ ǈŏơ! ǴŋlŏŽƙĂ ĎǴŧơŬƒ ƇǴƱƵǫ Ŏ5 ýŋďžƙ!ƒ" ĭĂŏþ ǈĂŋ ǋ5ƧƵĂ

Ŧŏ5Ƨƶďž!ƒ ƻƒþǋjü! ĎžĂŀŀ ƻŏǉƬƙ Ŏ5 ǴŏŽ!ƒ ŦλŭλΙƒ Ŧŏ5Ƨƶďž!ƒ ƘǴŏĂƙƪďž!ƒ ĎƒþƤƙƪǫ Ĭ!ƒ þpǴǉ!ƒ Ƨŏŧƽƙ!ƒ

.(65:2007 ÜǈƒĂƧŋ) " ĎŏĂlƙ!ƒĂ ÜƔŏŧƧƙ!ƒĂ Üýŏŀơƙ!ƒ"

Ŧŏŀlž!ƒ ƘǴùùŏŀďž!ƒ ý+Tŏ þpǴǉ!ƒ Ƨŏŧƽƙ!ƒ ǈĐ (Sternberg, 1999) ШƧǉǉƧŏƙƪ ăƧŏ Ǵďŧ

ĎŏǋǴƽďž ĎŀŽƙĂ ƘƒƧƒƧl!ƒ yǉƬĂ ÜƘŭŧTďž!ƒ ýơ! ƩǴǉ!ƒ ǴŋďžþƤƙƪŏ Ŏƙ!ƒ ƘŭŏλďžƙΙƒĂ ƘǴŏŋŏƙƒƧƙƪŰƒĂ

.lþŏþŋ

ÜĐǴŧơŬƒ ƇǴƱƵǫ Ŏ5 ýŋďžƙ!ƒ " ĂǋǋþpǴǉ!ƒ Ƨŏŧƽƙ!ƒ ǈĐ (181:2009) ŦŏƱƵ ăƧŏ Ǵďǉŏǉ

ÜĐŧơ ƧƒþƬǫ Ĭ!ǫ ýĂƬĂ!ƒ ƘǴŏŀďžƵ Ƨƪŏǒ ýĂƋƪďž Ƨŏŧƽƙ ĂǋǋĂ ."ƧďŬƒ ǈďž ƨ lơƙ!ƒ ǈŏơ! ǴŋlŏŽƙĂ

Ʃƪơƙ ŦŋƧþĂ ÜŎƙƒƦ!ƒ ĎŏĂlƙ!ƒ ĬŀƵ ĎĂlŏĂ ÜlþþơďžƘǴŧơďž ĂĐ ÜƧŏŏǴƶďž ƇĂư Ŏ5 ƧƒƧp ƦǴƤƙƒ ĂĐ

.ǉƧƬǴǉƵĂ ƻpĂďž!ƒ

ŦƵĂďžŋďž Ďưƙ ÜŦŏŀlƵ Ŧŏŀďžƶ " ǋǉǉǉ Ǵưŏǒ þpǴǉ!ƒ Ƨŏŧƽƙ!ƒ (370:2005) ĎŏǋƒƧǉ ƻƧƵĂ

ƔŏƙƧƙ ĭǉǉ Ďƒƨƙ!ƒ ǈĂþ ÜŦƶďžƙŋďž ĂĐ lþƧƽǉďž lƧĂƬǉ ĎþƤƙƪƙ ǈĐ ǈŧďžŏ Ŏƙ!ƒ Ƨŏŧƽƙ!ƒ ƘƒƧǴŋďž ǈďž

ƧƒþƬǫ ýŋĐ ǈďž ÜŦǉŏƶďž ƧŏŏǴƶďž Ĭ!ǫ þǴǉƙƪŰǴǉ ǋďžŏĂlƙĂ ÜƔĂưĂďž!ƒ ĂĐ ƇŎT!ƒ ǈďž ƨ lơƙŀ! ǈŏƶďž

."ƧƒƧp ĂĐ Ďŏďžƶƙ ĂĐ ШǴƙǉƙƪƒ Ĭ!ǫ ýƬĂƙ!ƒ ĂĐ ÜƇŎT!ƒ Ŧďžŏp ĬŀƵ Ďŧơ

ƠŏơƬ!ƒ ƻƧƬƙ!ƒ ǴŋΙŭƤ ǈďž þƧƽ!ƒ ǈŧďžƙ lƧǴŋďž ǋǉǉǉ (Ennis, 1985) Ʃŏǉƒ ǋ5ƧƵ þpĂ

þpǴǉ!ƒ Ƨŏŧƽƙŀ! ǈŏƙďžƪ (42:2007) ƨŭơ!ƒ ƧŧƦ Ǵďǉŏǉ ÜŦƽŀƙƤďž!ƒ ýƑǴƪďž!ƒ Ŏ5 ýďžƋƙ!ƒ ĬŀƵ ƭþďžƙƶďž

:Ǵďžǋ

- ǋďžǴŋƪǉƒ Ŏ lƱǉďž!ƒ ĭþƋďž!ƒ Ĭ!ǫ ƘƒƧƒƧp ƘǴŋǴƙǉƙƪƒĂ Ŧďžŏŀƪ.

- Ƨŏŧƽƙ ŎŀŽďžƙ Ŏǉǉďž ĬŀƵ ƘƒĂƱƤ Ʀƪƪƙƶďž ǈŧďžƙ ǴŋǉơǴƬ ǈďž ýƬĂƙ!ƒ Ĭ!ǫ ƘƒƧƒƧp

.Ŧďžŏŀƪ ƘǴŋǴƙǉƙƪƒĂ

[illegible]

[illegible] :(Kneedler, 1986:276)

1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]
5. [illegible]
6. [illegible]
7. [illegible]
8. [illegible]
9. [illegible]
10. [illegible]
11. [illegible]
12. [illegible]

ƨŏǂƼķ!ƒ ƙƒƧǴnjdž (Marazano *et al*, 1989:1074) ǇǍƧƤƒǍ ǍǇjƒƨƒƧǴdž ƊžƪŀƂ ǇǰơƠ Ŏ5

:ŎķŬǴǂ ǴnjķhǍƶƮ ýƪŀƪķ ƔƪơƕƙǴƵǍdžƞdž Ǐŀƶ þpǴǇj!ƒ

ȜǍƮ ƖƧǴnjdžǍ ÜǂŀǂTdž!ƒ þŏþơķ ƙƒƧǴnjdž :ǂŏƵƧƼ!ƒ ǴnjķƒƧǴnjdž ǇdžǍ ǉǴhķǉŰƒ ƨŏǂƧķ ƙƒƧǴnjdž . č

.ƊŏǊǴƼdž!ƒ ƻƧƶķ ƖƧǴnjdžǍ ÜƻƒþǊŰƒ

.ǂŀƑƪŰƒ ǂƸǴŏƮ ƖƧǴnjdžǍ ÜǂƱơǔdž!ƒ ƖƧǴnjdž :ǂŏƵƧƼ!ƒ ǴnjķƒƧǴnjdž ǇdžǍ ƙǴdžǍŀƶdž!ƒ ƴǭdžƞ ƖƧǴnjdž . Ď

.ƨǍdžƧ!ƒ ƴǒdžƞķ ƖƧǴnjdžǍ ÜƙǴdžǍŀƶdž!ƒ ƳǴƞƧķƪƒ ƖƧǴnjdž :ǂŏƵƧƼ!ƒ ǴnjķƒƧǴnjdž ǇdžǍ ƧǂƦķ!ƒ ƖƧǴnjdž . ď

. ƯƧƶ!ƒǍ ÜƻŏǉƮķ!ƒ ƖƧǴnjdžǍ ÜǂǇjƧǴǀdž!ƒ ƖƧǴnjdž :ǂŏƵƧƼ!ƒ ǴnjķƒƧǴnjdž ǇdžǍ ƊŏƱǇjķ!ƒ ƖƧǴnjdž . Đ

þŏþơķ ƖƧǴnjdžǍ ÜƙǴǇjǍǂdž!ƒǍ ƙǴdžƪ!ƒ þŏþơķ ƖƧǴnjdž :ǂŏƵƧƼ!ƒ ǴnjķƒƧǴnjdž ǇdžǍ ýŏŀơķ!ƒ ƙƒƧǴnjdž . đ

.ǅǴƱƤŰƒ þŏþơķ ƖƧǴnjdžǍ ÜǂŏƪŏƑƧ!ƒ ƧǴǂƼŰƒ þŏþơķ ƖƧǴnjdžǍ ÜƱǴdžǇjŰƒǍ ƙǴpǔƶ!ƒ

.ƋhǇjķ!ƒǍ ÜƠŏƯǍķ!ƒǍ ÜýŬþķƪŬƒ ƖƧǴnjdž :ǂŏƵƧƼ!ƒ ǴnjķƒƧǴnjdž ǇdžǍ ƙǴdžǍŀƶdž!ƒ þŏ!Ǎķ ƖƧǴnjdž . Ē

ÜƙǴdžǍŀƶdž!ƒ ǋdžþǍ ÜǅǴǇjƕ!ƒ ƚþǴƵƹǍ ƒ ŏƤŀķ!ƒ ƖƧǴnjdž :ǂŏƵƧƼ!ƒ ǴnjķƒƧǴnjdž ǇdžǍ ƔŏǂƧķ!ƒ ƙƒƧǴnjdž . ē

.ǂŏƧǍƧƯ!ƒ ƧŏƸ ƙǴdžǍŀƶdž!ƒ ƻƦơǍ

ƽþƮ ǇdžƽŀơķƒƖƧǴnjdžǍ ÜƧŏŏǴƶdž!ƒ ƴƯǍ ƖƧǴnjdž :ǂŏƵƧƼ!ƒ ǴnjķƒƧǴnjdž ǇdžǍ ƊǍŀķ!ƒ ƖƧǴnjdž . Ĕ

.ƙƒǴƵþŰƒ ǂơƮ ǏŀƵ ǇǰǊjƒƧh!ƒ ƊŏþŀķƖƧǴnjdžǍ ÜǊƑǴǇj!ƒ

ǇǰƵǍǇj ƙǇjdžƯķ ŎķƒǍ þpǴǇj!ƒ ƨŏǂƼķ!ƒ ƙƒƧǴnjdž ǇdžǍ ƭþþƵ ƙƶƯǍ þŀ5 ŎƼ!þ ǅƒƧhƤ ǂƑŏǊj ǴǉƵǊ

ƫŏƶ!ƒǍ ƖǴŏơ!ƒ ýƤƒþdž ǏŀƵ ýdžķTķǍ ýǍŏdž!ǴǇ ǏdžƪķŎķ!ƒǍ ǂŏǉjƒþƞǍ!ƒ ƙƒƧǴnjdž!ƒ :ǴdžǊj ƙƒƧǴnjdž!ƒ ǇdžǍ

ǴdžǂǂŏǴ!ǴƵ!ƒ ƙƒƧǴnjdž!ƒ ǇdžƯķķǍ ÜþpǴǇj!ƒ ƨŏǂƼķ!ƒ ƧǊjǍƞ ýǂTķ ŎķƒǍ ǂŏ5ƧƶǴdž!ƒ ƙƒƧǴnjdž!ƒǍ ÜǔdžǴƵ ýǂTƕ

:(Facione, 1998:28) ǍŏTǴ5 ǴǊjþƧǍƊ

ǂŏķŬƒ ǂŏƵƧƼ!ƒ ƙƒƧǴnjdž!ƒ ǇdžƯķƖŏǍ ǂ!Ŭþ!ƒ ǍƊ ǏǇjƶdž!ƒ ǇǰƵ ƨŏhƶƶ!ƒǍ ƊǊjƼ!ƒ ǍǊjǍ :ƨŏƪƼķ!ƒ . č

.ǏǇjƶdž!ƒ ƠŏƯǍķ ÜǎƨȜdž!ƒ ǍƊ ǂ!Ŭþ!ƒ ƒ ǔƤķƪƒ ÜƻŏǉƮķ!ƒ

ǂǃǶƮŪſĂ ƘſƧǄƶ!ſ ǇǊǄ ǂŏǀŏǀơ!ſĂ ǀþĂƬǀdž!ſ ƘŬŬþ!ſ ƘſƦ ƘǴpŭƶ!ſ þŏþơǩ ĂǋĂ :ýŏǃơǩ!ſ . Ď

ǇdžǇdžưǩŏĂ ƔǴǄƮǊ ĂǊ ǅǂơ ĂǊ þǴǀǩƵſ ǇƵ ƧŏǄƶǩǃ! ăƧƤǊ ýǴǂƬǊ ĂǊ ƘǴƽƬ!ſĂ ǅŏǋǴƽdž!ſĂ

.ǅƞơ!ſ ýŏǃơǩĂ þŏþơǩ ÜƧǴǂƽŪſ ƒ ơƽ :ǂŏǩŬſ ǂŏƵƧƽ!ſ ƘſƧǴǌdž!ſ

ǋǄƧǴƞǩĂ ƒ ƤƬ!ſ ǁſƧþǫ ƻƬǩ Ŏǩ!ſ ƘſƧŏǄƶǩ!ſ ĂǊ ƘſƧǄƶ!ſ ǂŏpſþƬdž ƩǴŏp ĂǋĂ :ǅŏĂǀǩ!ſ . ď

ĂǊ ǀþĂƬǀdž!ſ ǂ!Ŭþ!ſ ƘſƦ ƘǴpŭƶǃ! ǂŏǀƱǇdž!ſ ǀĂǀ!ſ ƩǴŏpĂ ÜǋǩſþǴǀǩƵſĂ ǋdžǴǂơǊĂ ǋƽpſĂdžĂ

ƘſƧǴǌdž!ſ ǇdžĂ ƧŏǄƶǩǃ! ƧƤƈ ý ǂƬ ĭǊ ĂǊ ÜǂǃǶƮŪſ ÜƻǴƬĂŪſ ÜƘſƧǄƶ!ſ ǇǊǄ ǂŏǀŏǀơ!ſ

.ǋƞơ!ſ ǅŏĂǀǩĂ ƘſƇǴƵþŬſ ǅŏĂǀǩ ǅŏĂǀǩ!ſ Ŏƽ ǂŏƵƧƽ!ſ

ǇŏĂǂǩĂ Üǂ!Ăǀƶdž ǋƑǴǩǈ ƒ ŭƤǩƮŬ ǂdžƨŭ!ſ ƧƬǴǈƶ!ſ ƧŏƽĂǩĂ þŏþơǩ ǋǄ þƬǀŏĂ :ýŬþǩƮŬſ . Đ

ǇǊǄ Ŏǀŏǀơ!ſ Ĭǈƶdž!ſ ƘſƦ ƘǴpŭƶǃ! ǂŏǀƱǇdž!ſ ǋƑǴǩǈ!ſ ƱǴǄǈǩƮſĂ ÜƘǴŏưƧƽĂ ƘǴǈŏdžƤǩ

Üǂŏ ƵƧƽ!ſ ýŬþǩƮŬſ ƘſƧǴǌdž ǇdžĂ ƧŏǄƶǩǃ! ƧƤƈ ý ǂƬ ĭǊ ĂǊ ƘǴƽƬ!ſĂ ƘǴǈǴǄ!ſĂ ƘſƧǄƶ!ſ

.ƘǴƞǴǩǈǩƮſ Ĭ!ǫ ýƬĂǩ!ſĂ ýƑſþǄ!ſ ǇŏdžƤǩĂ ýŏ!þ!ſ ƒ ơƽ

Üǂ!þŪǴǄ ƧŏǂƽǩǃƵ ǁ!ƦƺŏĂƮǩĂ Ŏǀ ƱǇdž!ſ ƧŏǂƽǩƵ ǋƑǴǩǈ ǇŭƵǫ ĬǃƵ ǀƧþǀ!ſ ŎǈƶŏĂ ƟƧƬ!ſ . đ

ÜǋƑǴǩǈ!ſ ǇŭƵǫ :ǂŏƵƧƽ!ſ ƟƧƬ!ſ ƘſƧǴǌdž ǇdžĂ ƾǴŏƮ!ſĂ ƧŏŏǴƶdž!ſĂ ǂŏƞǌǈdž!ſĂ ÜǅŏǋǴƽdž!ſ

.ǋƞơ!ſ ƯƧƵ

ǂdžþƤǩƮdž!ſ ƧƬǴǈƶ!ſ ǂǄpſƧdžĂ ƳſĂ ý ǂƬǄ ǂŏƽƧƶdž!ſ ǋǩǴƱǴƬǈ! þƧƽ!ſ ǂǄpſƧdž ĂǋĂ ƘſƦ!ſ ǅŏƲǈǩ . Ē

ǅŏŏǀǩĂ ÜýŏǃơǩƩ ǀƧǴǌdž ƾŏǄƱǩ ǆǴǈǊ ƒ ǴƤ ý ǂƬǄĂ ǂƬǃƤǩƮdž!ſ ǋƑǴǈ!ſĂ ƘǴƱǴƬǈ!ſ ǈƦǌ Ŏƽ

ǆſĂƮ ơŏơƬǩ!ſĂ ǂŏpſþƬdž!ſĂ ƾǀơǩ!ſĂ ýƌǴƮǩ!ſ ĂơǇ ǀƧƲǈ!ſ ýdž ǂŏ!ŬþǩƮŬſ ǋdžǴǂơŪ ǆƧdž!ſ

ƠŏơƬǩĂ ƘſƦ!ſ ƧǴǄǩƤƭ ǴdžǌǊ ǀƧǴǌdž!ſ ǈƦǌ! ǇǴǩŏƵƧƽ!ſ ǇǴǩƧǴǌdž!ſĂ ǋƑǴǈ!ſ ǅǊ ƧǴǂƽŪſ ƠŏơƬǩ

.ƘſƦ!ſ

(110:1982)

ŀŏŋďžƨħ!ƒ ƽŏħƱķĂ ƥpǴŀj!ƒ ƨŏǂƽķ!ƒ ƨǴħķƤƪ ĈǴŀjħ ƥŀjƵ ƘƒƨǴnjďž!ƒ ljƦNj ƳĂŀjķ ƨǴħķƵǗƒ ǇŏžħƦƤǕƒ

.ŀʅƒƨƥ!ƒ ljƦNj Ŏ5 Ŏưƒƨķ5Ǘƒ ƨħķƤďž!ƒ Ŏ5 ŀďžƑǘďž!ƒ ŀŏħĂʅǴơ!ƒ

ħĬǂDžƴǁǁ lɛƥƑNjDžǁɛ :ƘǁƑķǁɛ ƥNjƟDžǁɛ

Ŏù5 ýùďžz!Ǵħ ǴùNjƨŏƹ ǇùƵ ƨùŏďžķķ Ŏķ!ƒ ŀŏʅǴʅǕƒ ƥƒĂďž!ƒ ŀƽǁķƤďž!ƒ ǴnjƵĂƨƽħ DžĂǁz!ƒ ƥzƘ

DžĂùǁz!ƒ Ŏù5 ƨùħķƤďž!ƒ Ĭùǁƶ ǇĂƨùǂƨŏ ǇŏŏĂùħƨķ!ƒ ǇùďžƨŏƛǂƓ!ƒ ýzŋ Ǵďžďž ÜŀŏǁďžžƓ!ƒ ƘƒƨħķƤďž!ƒ

Džùǁzķ ýŏnjʅùķ Ŏù5 lƨùŏħǂ ŀùŏďžNjĐ Ǉďž Ǵnj! Ǵďž! ǁ!ƦĂ ÜDžĂǁz!ƒ ƩŏƨƥķŎ5 ǴŏʅǴʅĐ ǴŀjĂǂďž ljƨǴħķƵǴħ

yùpƒĂ Ĭù!ƽ ƘǴùŏƨǓŀj!ƒĂ ǇŏŀjƒĂùǀ!ƒ ƽùŏħƱķ Ŏ5 ŀƺ!Ǵħ ŀŏďžNjĐ ŀŏǁďžž!ƒ ƘƒƨħķƤďžǁ! ǇĐ Ǵďžǂ ÜDžĂǁz!ƒ

ýƑǴùʅĂ!ƒ ǇùďžǴưùŏĐ ŎùNjĂ DžŏùǁzķƓ!ƒ Ŏù5 ŀƛŏƥơ!ƒ ƘǴŏŀjǀķ!ƒ ƘǴďžĂǀďž DžNjĐ Ǉďž ƥzķ Ŏnj5 ÜƩĂďžǁďž

Ɣù!ǴƱ!ƒ Ǵùnjŏ5 Ăùďžŀjŏ Ŏùķ!ƒ ŀùƑŏħ!ƒ ƨħķzķ ŀŏơ ÜDžĂǁz!ƒ ƩŏƨƥķƘǛǴŋďž Ŏ5 ǴnjŀjƵ ĬŀjƹǗŎķ!ƒ

ƽƑǴùǀơ!ƒ ǇùďžƨùŏƛǂƓ!ƒ Džùnjƽ! ǴùʅǴʅĐĂ ŀƵĂŀjķďžĂ lƥƥzķďž ŀŏʅơ ƘƒƨħƤ ƨŏ5Ăķ ĬǁƵ ljƥƵǴʅķ ǴnjŀjǕ

.(2004 ÜǇŏNjǴƬ Ý2006 ÜyǴǴƮ!ƒ) ƨNjƒĂǓ!ƒĂ DžŏNjǴƽďž!ƒĂ ƘǴďžĂǁzďž!ƒĂ

ŀùŏơ ÜDžĂùǁz!ƒ ƩŏƨƥùķĂ ŀùŏďžǁz!ƒ ŀùŏħƨķ!ƒ Ǉďž Đƨŋķŏ Ǘ ƪǴƨŋ Ŏǁďžz!ƒ ƨħķƤďž!ƒ ƥzŏĂ

Ŏ!Ăùķ ǁ!Ʀù! ÜĭƨùħƤďž!ƒ ýùďžz!ƒĂ Ŏùǁďžz!ƒ Ɣùŏƨŋķ!ƒ NjħơƱƬùŏ Džù! Ǵďž ǴďžǁƵ Ʃŏ! Džǁz!ƒ ǇĐ

Ʃŏƨƥùķ Ŏù5 ƪƨƨǴùħ ƪƨĂƥĂ ƨùħķƤďž!ƒ Ŏù5 ŀŏďžǁz!ƒ ƘǴƱǴƬŀj!Ǵħ DžǴǴďžķNjǗƒ ŀƛŏƥơ!ƒ ŀŏďžǁz!ƒ ŀŏħƨķ!ƒ

ǇĐĂ ÜŀùŏďžǁƓ!ƒ ƘƒƨƨùǀďžǁƓ ǴŏùʅǴʅĐ ƪǴƨùŋ ƨùħķƤďž!ƒ Ŏù5 ŀŏǁďžž!ƒ ƔƨǴŋķ!ƒ ƥzķ ŀŏơ ÜDžĂǁz!ƒ

ÜŀùŏǁǀƓ!ƒ ƘƒƨǴùnjďž!ƒ ŀùħǁƱ!ƒ ƔǴʅùǂƽ Ŏù5 ƨùŏħǂ ýǂƬùħ Džnjʅķ ŀŏďžǁz!ƒ ƔƨǴŋķ!ƒĂ ƘǴƱǴƬŀj!ƒ

ƧùŏǂƧƨùžŏ ǇĐĂ ǴùŏǀƱŀjďž ƨʅùƽŏ ǇĐ Ǵùďžnj!ǗƤ ǇùďžDžǁzķďž!ƒ ǇǂďžķŎķ!ƒĂ ÜŀŏǁďžžƓ!ƒ ƘƒƨǴnjďž!ƒĂ

ƽùŏǀơķ Ŏù5 ƨùŏħǂ ýǂƬùħ DžnjʅùķǴùnjŀjĐ Ǵùďžǂ ÜƘǴħƛǗƒĂ ýŏ!ƥ!ƒ ĬƬǀķŏĂ ǇǴNjƨħ!ƒ ǇƵ ŀơħŏ

ǇŏNjǴùƬ Ý2001ÜǇĂùķŏƨ) ljƨùǂƦ Ǵùďž ǴùnjŀjďžĂ ƩŏƨƥùķƓ!ƒ Ǉùďž lƥĂƬŀjďž!ƒ ƧƒƥNjǕƒ Ǉďž ƥŏƥz!ƒ

:(2005 ÜƔǴƱơĂ

.Ŧŏďž̈z!ƒ Ŧ5Ƨƶďž!ƒ ƔĜƪƙǂƪ Ĭ̈Ʒ Ŧƕ̈Ʊ!ƒ ƖƥƷĜƪďž -1

.ǇƙŏďžǉƙĂ ǅžŏ̈ƪ!ƒ Ŏďž̈z!ƒ Ƨŏǂƽƙ!ƒ Ĭ̈Ʒ Ŧƕ̈Ʊ!ƒ ƔŏƧƥƙ -2

.ĜǌƙŏďžǉƙĂ Ŧŏďž̈z!ƒ ƘĜǋĜƞƙŰƒĂ ǅ̈z!ƒ ƘĜŏ̈ďžƷ ƔĜƪƙǂƪ Ĭ̈Ʒ Ŧƕ̈Ʊ!ƒ ƖƥƷĜƪďž -3

.Ŧƕƪ Ĝǉďž!ƒ Ŧŏ̈ďžz!ƒ ƘƒƧĜǌďž!ƒ ƔĜƪƙǂƪ Ĭ̈Ʒ Ŧƕ̈Ʊ!ƒ ƖƥƷĜƪďž -4

ÜǊùƪƒĂơ ǇďžùƯ ƴùƖƙ ŎùƙƒƧĂùďžǕƒ ƻ̈ƙƤďž Ŏ5 Ŧƥƥ!ƒĂ ŦƱơǖďž!ƒ Ĭ̈Ʒ Ŧƕ̈Ʊ!ƒ ƔŏƧƥƙ -5

.ŦƖŏƥƥ ƘƒƧƕƤ Ĭ!ƥ ǋƕ ýĂƮĂ!ƒĂ ǺơŏơƮ Ǻďžƒƥƙƪƪ Ŧŏďž̈z!ƒ ƖƨǌƞǕƒ ǅƒƥƤƙƪƪ Ĭ̈ƷĂ

ǇŏǋĜƮ ƥǂǅ ƥƥĂ ÜĜǉƙĜŏơ Ŏ5 Ŧďžǌďž!ƒ ŦŏƖŏƕƱƙ!ƒ ŦŏƧƕƤďž!ƒ ǅĂ̈z!ƒ ƳĂƧ5 ƥơǅ Ŧƪƥǉǌ!ƒ Ƨƕƙƶƙ

Ŏ5 ƧƕƙƤďž!ƒ ǅƒƥƤƙƪƪ Ŏ5 Ŧďžŏƥl!ƒ Ŧƽƪ̈ƽ!ƒ ǇƷ ŦƛŏƥƠ!ƒ Ŧƽƪ̈ƽ!ƒ ƨŏďžŏ Ĝďž ǅǊǅ Ǉǅ (2005) ƔĜƱơĂ

Ŧŏ̈ďžƷ Ŏǋ ýƕ ÜŎ̈ďžz!ƒ ƔǉĜƞ!ƒĂ ĭƧƲǉ!ƒ ƔǉĜƞ!ƒ ǇŏƕƮƽ!ƒ Ĭ̈Ʒ ǅĂƖƙ Ŭ ĜǌǉǅĂ̈z!ƒ ƩŏƧƥƙ

Ǉǅ Ŧŏơƕ Ǻŏ̈ďžƷĂ ǺŏƧƲǉ Ŧŏďž̈z!ƒ ƖƥĜďž!ƒ ƩŏƧƥƙ Ĭ!ƥ ĂƷƥƙ Ŏǌ5 Ŏ!Ĝƙ!ĜƕĂ ÜĜƶďž ǇŏƕǉĜƞ!ƒ Ǉŏƕ Ŧŏ̈ďžĜǂƙ

ĈƒƧƞƥ ĈƒƧĂ Ǉďž ŦŏĜƺ!ƒ Ǉƪ .ƩŏƧƥƙ!ƒ Ŏ5 ĭƧƲǉ!ƒ ƔǉĜƞ̈! ƥǂƋďž!ƒĂ ǅƷƒƥ!ƒ Ŏǋ Ŧŏ̈ďžz!ƒ ƔƧĜƞƙ!ƒ

Ŏ5 ŦǂƧĜƮďž!ƒ Ŏǋ ŦŏĜƺ!ƒ ĜďžǉƪĂ ÜƾƕĜƪ!ƒ Ŏ5 Ɣ!ĜƱ̈! ĜǌƪŏƧƥƙ ǅƙ Ŧŏďž̈Ʒ ƖƥĜďž ƘĜƕƛƥ Ƙƪŏ! ƔƧĜƞƙ!ƒ

Ʊơǖŏ Ɣ!ĜƱ!Ĝ5 ÜǅžƙƖ!ƒ Ŏ5 ŎƕĜƞŏǕƒ ƧĂƥ!ƒ Ĭ!ƥ Ŏƕ̈ƪ!ƒ ƧĂƥ!ƒ Ǉďž Ɣ!ĜƱ!ƒ ýĜƖƙǉƥĂ Ŧŏďžŏ̈ƶƙ!ƒ Ŧŏ̈ďžz!ƒ

Ŏ5 ƔƧĜƞƙ!ƒ ƧƒĂƥǅ Ǉďž ŎƕƮǅ Ɩ!ƦƕĂ ÜǊƑĜƙǉ!ƒ ǇĂƥŏĂ ǋƙǉƙƪŏĂ ǄƕǉƙŏĂ ƯƧƙƽŏĂ ƩŏƖŏĂ ƫƥĜǉŏĂ

ÜŎǉĜz!ƒ) ýƯ5Ǖƒ ǅ̈zƙ!ƒ Ăơǉ Ɣ!ĜƱ!ƒ ƨŏƽơƙĂ ƖƥŏƥƞǕĂ̈ơ Ɣ̈Ʊƙƙ ƘŬƋĜƪƙ ƖƧĜƺ ƧƕƙƤďž!ƒ

.(1987

Ŧ̈ǋžǂďž!ƒ ƾƧƱ!ƒ Ǉďž ǋǉǅ Ĭ̈Ʒ ǅĂ̈z!ƒ ƩŏƧƥƙ Ŏ5 ƧƕƙƤďž!ƒ ƧĜƕƙƷƒ Ǉǂďžŏ Ŭ ƾƕƪ Ĝďž ýǕƤ Ǉďž

Ɣƞŏ Ŧŏďžŏ̈ƶƙ!ƒ Ŧŏ̈ďžz!ƒ Ŏ5 ƧƕƙƤďž!ƒ ŦŏďžǋǕĂ ÜŦŏƪĜƪǅ ƩŏƧƥƙ ŦŏƧƱĂ Ŧơ̈ďž ƖƧĂƧƯ Ƨƕƙƶŏ ýƕ

Ŧƕ̈Ʊ̈! Ŧƕƪǉ!Ĝƕ ŎƯƒƧƙ5Ǖƒ ƧƕƙƤďž!ƒ ƥƶŏĂ ÜǅĂ̈z!ƒ ƩŏƧƥƙ Ŏ5 ǉƧĂƥ ƾĂƶŏ Ǉǅ Ǉǂďžŏ Ĝďž Ĭ̈Ʒ Ɣ̈ƺƙ!ƒ

Ŏ5Ă ǊƑĜƙǉ!ƒ ĈĜƱƷƪ Ŏ5 ŦƷƧƪĂ ýǌƪ ýƷĜƽƙ ƥĂƞĂ Ǉďž ŦŏƞďžƧƕ!ƒ ĜŏƒƨďžƔƕƪƕ Ɩƥŏƥƞ ŦŏƧƱ

[illegible] .(2011 [illegible]) [illegible]

[illegible]

.(2009 [illegible]

[illegible]

[illegible]

.(2008

hŭǂDžy‖ع l ٤ђƒNJDŽ‖ع hŭŤDždžǂ

Ʀƒ٢Ǵnjdžǃƒǂǂőďžǈƙǃǂďžƨűǃƒ ƱĂ٢Tǃƒ Ă ƏþǴƕdžǃƒ LJdž ǂƵĂdžɳdž ‖ǴǈNj LJD (1999) LJǴǆ٢ ă٢ő

Džnjƽő LJDĂ ÜǴnjǈƶ ǚ Ʈ ƽǈdž Σ őǃĂ ǂőʅƒ٢þǃƒ lþǴdžǃǴƕ ǚ Ʈ ƙdž ǴőƽőƲĂ Ǵnjʅő٢þƙ LJĂǂő LJD Ǵnjǈǈdždžǂőǈdžƨǃƒ

Džǃǈƨƙdžǃƒ ƴƜƤő LJD Ǵ ƜőDĂ ÜǴnjƙőďžǈƙǃ ƨƼǴơǃƒ NJǃ ٢ƼĂƙő LJDĂ ÜǴnjǈǈdž Ư٢ƺǃƒĂ l٢Ǵnjdžǃƒ Ǐǈƶdž Džǃǈƨƙdžǃƒ

LJDĂ ÜƇƒþǖǃ ٢TǴƕdžǃƒ DžőĂlƙǃƒĂ ٢ƒ٢ǂƙǃƒ ƒ ٢Ƽ ƴdž l٢Ǵnjdžǃƒ ƽőƕƱƙǃ Ǐ ǃĂǕƒ NJƙǕĂǴơdž ǇǴǈĂD ƻƒ٢Tǚǃ

Džǃǈƨƙǃƒ ǂǈĂ٢dž ƴdž Üă٢Ƥǖ ǂőʅƒ٢þ ǂǈʅ LJdž þőlƨƙǃƒ Ǒ٢ lþőƒƨƙdž ƦǴőĂƙʅdž LJdž Ɯ l٢Ǵnjdžǃƒ Džőþlƙ Džƙő

Ʀƒ٢Ǵnjdž Džǃǈƨƙƕ Ơdž ʅő Ǵdždž Džǃǈƨƙǃƒ ٢ƛD ƴǴlƙǈD LJdž LJǂdždž ٢þp ٢ƕǂD ƽőlơƙǃ ǂƵĂǈƙdž ƻpƒĂdž Ǒ٢ ƽőƕƱƙǃƒĂ

.Ǵƨdž ǂƽǃƙƤdž

ƴdžTƙ (2006 ÜƯĂƵĂ þǴőƵ) Džǃǈƨƙdžǃƒ Ǵnjƕ ٢džő ƦƒĂƱƤ ǂőǃdžƨǃƒ Ʀƒ٢Ǵnjdžǃƒ Σ ő٢þƙǃ LJǫ

Ǵnjʅő٢þƙ ƻƒþNJD þőþơƙ ‖ǃƦǂĂ ÜDžǃǈƨƙdžǃǃ ǂƕʅǈǃǴƕ l٢Ǵnjdžǃƒ ǂőďžNJD ƠőƜĂƙ ƴƛdž ǂőǃdžƨǃƒ l٢Ǵnjdžǃǃ Džőþlƙǃƒ

ǴnjőǃőĂ .ǴnjƕǴʅƙǂŮ ǂő٢Ă٢Ɯǃƒ ǂlƕǴʅǃƒ Ʀƒ٢ǴnjdžǃƒĂ ƦǴdžĂǃƨdžǃƒ ǂƨɳƒ٢dž ƴdž ǂőďžĂőǃƒ ǴǈƙǴőơ Ǒ٢ ǴnjƙőďžNJDĂ

Ǵdž ǑNjĂ ÜƦƒĂƱƤǃƒ LJdž ǂǃʅǃʅ ƴǂT Ǐǃƶ ǂőþǴT٢Ǘƒ ƦǴdžőǃƨƙǃƒ Ɵ٢Tő ƴǴƛdž ƴűƤ LJdž l٢Ǵnjdžǃƒ Ư٢Ƶ

٢őʅƽƙ LJdž ǴƜőD þƕŮĂ .ƦőƽǈƙǃƒĂ Ư٢ƨǃƒ ǇǴǈƛD ǂǃƮ Ʀƒ٢ ǂǃƛdžD ǇǴƱƵǫ ƴdž l٢Ǵnjdžǃƒ ǂődžƨ٢ƒĂƤƕ ƻ٢ƨǅ

ǇǴƱƵǫ ƴdž ǂlő٢Ʊ LJdž ٢ƛǂƕ ǴnjlőƕƱƙĂ ÜǴnjőǃƵ þǈƙʅƙ Ǒƙǃƒ ƦǴdžőǃƨƙǃƒĂ ƏþǴƕdžǃƒ ƠőƜĂƙĂ l٢Ǵnjdžǃƒ

NJƽőǃǂƙ ƽő٢Ʊ LJƵ l٢Ǵnjdžǃƒ ǈƦnjǃ ƔǃǴƱǃƒ ƔǴʅƙǂǫ ăþdž DžőĂlƙĂ Ül٢Ǵnjdžǃƒ ǂʅ٢Ǵdždžǃ ǂƮ٢Ƽ ƔǃǴƱǃƒ

.Ů DžD lǴǴƽǂĂ ǂþþƕ l٢Ǵnjdžǃƒ ǈƦNj ƦƽǈƒNj ƴNj DžǂơǃƒDžƛ LJdžĂ ǴNjƦőƽǈƙƕ

hŭǂDžy‖ع l ٤ђƒNJDŽ‖ع ٢ƒĭƽ

ǂőǃdžƵ ƽő٢Ʊ LJƵĂ Üĭ ٢Ǵnjdžǃƒ ƇƒþǗƒ ăĂƙʅdž DžőĂlǃ ǂdžƨŮĂ ǂő٢Ă٢Ɯ ǂőǃdžƵ Σ Ǵőlǃƒ þƶő

ƴơƒ٢džǃƒ Ǒ٢ ƇƒþǗƒ Džʅƙ őĂ ÜƇƒþǖƒ Ǒ٢ ٢ĂƮlǃƒ ĂD ƟǴɳǈǃƒ ăĂƙʅdž þőþơƙĂ ǂƼ٢ƶdž LJǂdžő Σ Ǵőlǃƒ

ǂƑőƱƕ lþǴƵ ƦǴǂ٢ơǃƒ LJĂǂƙ ǂőơ ǂƵƒ٢ƕǃƒ Džþƶƕ lþǴƵ ǂƽǃƙƤdžǃƒ ǴnjƵƒĂǈƛƕ Ʀƒ٢Ǵnjdžǃƒ Džǃǈƨƙ LJdž l٢ǂƕdžǃƒ

[illegible]

[illegible]

[illegible]

.(2007 [illegible]

: [illegible] (2004) [illegible]

- [illegible]

[illegible]

- [illegible]

[illegible]

[illegible]

: [illegible]

1 - [illegible]

: [illegible]

- [illegible]

. [illegible]

- [illegible]

. [illegible]

- [illegible]

[illegible]

. [illegible]

2- [illegible]

[illegible]

[illegible] (2002) [illegible]

- [illegible]

- [illegible]

- [illegible]

- [illegible]

(1995) Lierman (1994)

(2004)

(1995) (Lierman, 1994)

(1997)

Ǵnjǒþƌǒ Ǒǩ!ƒ Ǝǒǉǆƶ!ƒ ƘƒĂƱƤǉ! ǼǉƮĂ ǁǴǈǋ ǇĂǂǒ ǇǊ (2003) ǐĂƒƨƺĂ ƫ Ƨnj!ƒ ƟƧǩþƫ Ǵǆǂ

ǇĂǂǒ Ǵǆ ǘǂ ǑǋĂ ƘǴƬǴƬ!ƒ ĂǊ ƘƒƧǴƱǗƒ ǅǒǆƮǩĂ ǗƧǴƱǗƒ ǇǒǉĂ ǊǇǒǉ ǘƵǴƽǩ!ƒ ǂƒþơǗ ǅþƤǩǃǆ!ƒ

ƔƞǒĂ .Ǵnjƶǆ ǘƵǴƽǩǒ Ǒǩ!ƒ ǂǆĂǃƧǆ!ƒ ǅƑƒĂǀ!ƒĂ ƧƒƧƨǕƒ ǘǂĂ ǅƒþƤǩǃǕƒ ǂƲơ! Ǒƽ ǅǉƶǩǆǉ! ƪƧǋǴƲ

ǘǆ ǗǂǀƑǗ ǂƱǒǃǉ ǀƧĂƮǉ ǖƧƤǩ ǏǩƠ ǂƬǴƬ!ƒ ǅǒǆƮǩ þǈƵ Ǽƶǆ ǂǒǈƽ!ƒĂ ǂǒǆǒǉƶǩ!ƒ ƧǒǒǴƶǆ!ƒ ǀǴƵƒƧǆ

ǂƶƞƒƧ!ƒ ǂǒƦƺǩ!ƒ ƱǴǆǈǊ Ă ǂǉǴƞǩǃǗƒ ƱǴǆǈǊ þǒþơǩ Ă ǅǉƶǩǆ!ƒĂ ǂǒƞǆƧǉ!ƒ ǇǒǉĂ ǘƵǴƽǩ!ƒ ǂǒƽǒǂ þǒþơǩ

.ǴnjǆǒǆƮǩ ǇǆǅǆƮǆ!ƒ ǑnjǩǈǒǑǩ!ƒ ƘƒĂƱƤ!ƒ ǘǒǆƞ! ƧǆǩǃǆǅǒĂǀǩ ĂǋĂ ǑƑǴǉǉ!ƒ ǅǒĂǀǩ!ƒ ǁ!ƦǂĂ

ĂǊ ǼơǼƣǒǊ ǘǕǆǒ ǼƞƦĂǆǈ ǘǆƬǩ! ǂǒǉĂǃǴơ!ƒ ǀǴǂǴơǆ!ƒ ƧƮǴǈƵ (1995) Ƨþǉ ƻƧƵ Ǵǆǂ

ǘƵǴƽǩ!ƒ ǂǉǒǃĂĂ ǖƦĂǆǈ!ƒ ǁĂǉǃ Ǆǂơǩ Ǒǩ!ƒ þƵƒĂǀ!ƒĂ ƔĂǃǴơ!ƒ ǘǜƤ ǇǆǆǑǀǒǀơ!ƒ ƻƥĂǆǉ! ǼƱǒǃǉǩ

ǀǴǂǴơǆ!ƒ Ǉǆǉ (2009) þĂƶǃ!ƒ ĂǉǊ ǡƧǒ ǇǒơǑƽ ǗƘƒƧƒƧǀ!ƒ ǏǉƵ ƔǒǀƶǩƒĂ ǂƶƞƒƧ!ƒ ǂǒƦƺǩ!ƒĂ

:ǴnjǈǆǇ ǀþƵ ǘǴǂƬǊ Ǵnj! ǂǒǉĂǃǴơ!ƒ

ǐĂǩơǩ ǂǒơ ǘþƒĂ!ƒ Ǒƽ þƞĂǒ Ǵǆ! ǂǉǆǆǆǆǆ ǊǆƒƧǉ!ƒĂ ǀƨnjƞǕƒ ǇĂǂǩ ǂǒơ : ǘþƒĂǉ! ƪǉǴƱǆ ǖƦĂǆǈ -

.Ǽǒǉǃǈ ǀƧƺƮǆ ǇĂǂǩ ǴnjǈǂƒĂ ǂǉĂǉƱǆ!ƒ þƒĂǆ!ƒĂ ƘƒƨǒnjƞǩƑ ǘǆǴǂ ǏǉƵ

ǊǉƧǀǩ ǂǒƶþƒĂǉ ǊǉĂǴǈǩ ǅǩǒ Ǉǒƶǆ ǑǆǉƵ ƻþĂǆ! ǖƦĂǆǈ ǘǆƵ ǏǉƵ ǂǀǒƧƱ!ƒ ǈƦǋ ǅĂǀ :ƧƒĂþǕƒ ǘǒǅǆǩ -

ǘnjǃǩ ǂƱǒǃǉ ǂǀǒƧƱǉ ǀǴǂǴơǆ!ƒĂ þǒǉǀǩ!ƒ Ǒƽ ƻþƒĂǆ!ƒ þơǊ ƧƒĂþǕƒ ǘǒǅǆǩ ƧǉǩƶǒĂ ǗǂǉǉƱ!ƒ ǇǴǋƦǊ ǏǩǤ

.ǂǉǉƱ!ƒ ǏǉƵ ǅnjƽ!ƒ

ƠǒǩǒƒƦǋĂ ǗǴnjǒǉƵ ƪƽǩǆ!ƒ ǇǒǈƒĂǀ!ƒ ƔǃƠ ǇǒǆǉƶǩǆǇ ǇǒǉƩƽǴǈǩ ǁǴǈǋ ǇĂǂǒĂ :ǂǒǃƽǴǈǩ!ƒ Ăƒ ǂǀǴǃǆ!ƒ -

ǘǆƬǩ!Ă ǀǴǂǴơǆ!ƒ ƧƮǴǈƵ þĂƞĂǉ ǕƤƒþǩǆ ǼƞƦĂǆǈ ǘǒǂƬǩĂ ǅǋƭƶǉ ǘǆ ǖǴǆþǈǕ! ǂƮƧƽ!ƒ ǂǉǉƱǉ!

.ǂƵĂǈǩǆ!ƒ ǂƱƬǈǕƒ

:Ǒǉǒ Ǵǆǂ ǑǋǊ ǅǴǃǀǊ ǂƶǉƧǊ ǏǩǤ ǂǒǉĂǃǴơ!ƒ ǀǴǂǴơǆ!ƒ (1993) ǏǃǒƶǆƑ ǅǃǀ þǀĂ

[illegible] .(2009[illegible])

[illegible] (Babateen, 2011)

[illegible]

مشاركة إيجابية ونشطة من كل من [illegible]

المعلم و [illegible].

[illegible]

[illegible] (Circuit Maker) [illegible]

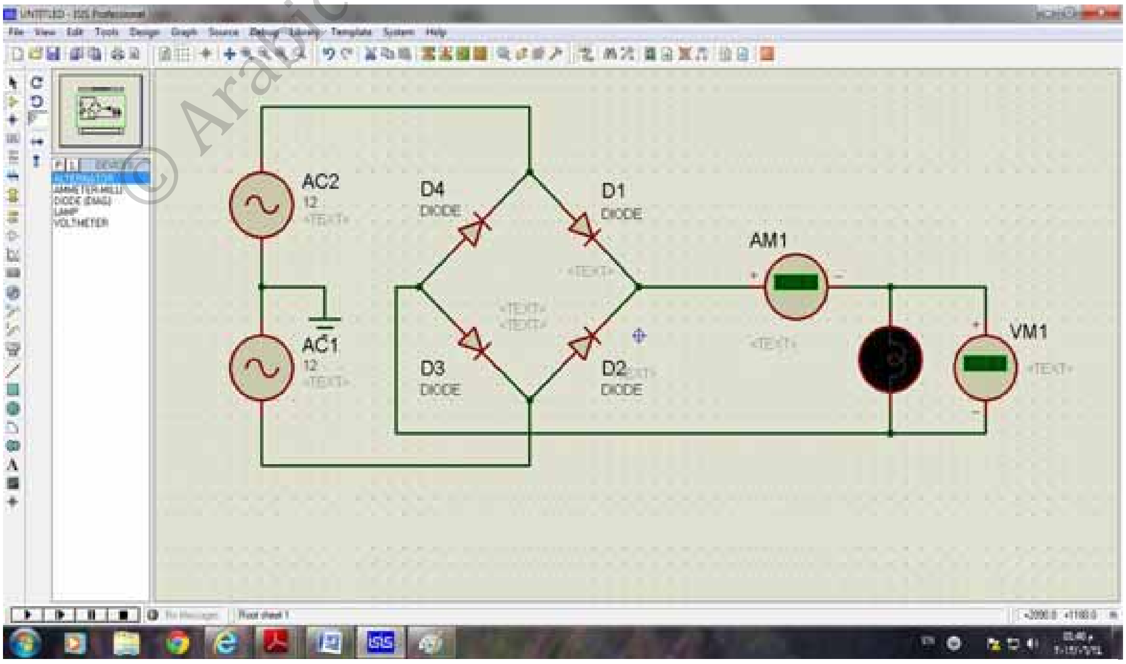
[illegible]

[illegible]

[illegible]

(Proteus) ΣĂŏƙĂƧƶ Ŧŏηďžƨƶ -1

Ŧŏơ ŦIJƧďžĂ ŦIŏþþĂ ŦzŏƧʅ ŎNjĂ ÜKŬĞďžƙʅŰƒ IJþþzƙďžĂ ĈƒþŪƒ Ŧŏ!ĜZ ƖĜŦĜơďž Ŧŏηďžƨƶ ŎNj ƝƑĜùƙǉ!ƒ ƒ ŭPƙʅƒ ǇŦďžŏ Ĝďžŧ Ü2zư!ƒ ƧƒþIďžƶ ăƧPŪƒ ƖĜŦĜơďž!ƒ ƘĜŏηďžƨƶ Ư zƶ ǇďžYƧʅD þzƙ Ŧùƶŏƨp ĎŏďžĜʅùƙ!ƒ ǇďžŦzʅƒĂ ŦZĂďžηďž ƖĜŦĜơďž! ÜŦ!ĂnjʅƶĜnjǉŏĂŦƙ Ďƙŏ IJþþzƙďž ƘĜη!Ĝzďž ýŭP Ǉďž ƧƒƒĂþù!ƒ YƒĂùǉD Ŧù5ĜŦ! IJþþzƙďž ƘĜIŏƶƱƙ Ƨ5Ăƙ ĜnjǉĴƶ Ŧŏηďžƨƶ!ƒ ǉŖNj ƨŏďžƙƙ Ĝďžŧ ÜŎIďžz!ƒ ýþƒĂI! ƭþη ŎηĂù!ĂǉŦƙ!ƒ ƧĂùƱƙ!ƒ Ɣƶʅ ƶĂ .(Brewer & Colbrook, 1991) Ŧŏ!ĜZ Ĉƒþƒ ŦþþƶĂ Ŧ5ĬƙPďž!ƒ Ŏù5 Ĝùďžƙơ Ďnjďž Ŧŏηďžƨƶ!ƒ ƖĜŦĜơďž!ƒĂ ƧƒƒĂþ!ƒ ĎŏďžʅƙƠƶʅD þI5 ÜIƧŏƶŦ!ƒ ŦZƧʅ!ƒ ǉŖnjƶ ƧƙĂŏƶďžŦI! Ŏù5 - ΣĂùŏƙĂƧƶ IJ ĜùŏηĂ!ĂǉŦƙ!ƒ ǉŖùNj ƘIPþD Ɣƶʅ!ƒ ƒŖnj! ÜŦŏþơ ŎǉĂƧƙŦ!ջ ĎĜUǉ ĭD Ďŏďžʅƙ ƘĜùIŏƶƱƙ!ƒ Ǉďž þŏþz!ƒ ŦʅƧĜďžďž Ŏ5Ă ĎŏIzƙ!ƒ ýĜηďž Ŏ5Ă ŦŏƑĜƶƧnjŦ!ƒ ƧƒƒĂþ!ƒ ϴŭʅĦŦ IJþZ ƘŬĜηďž Ơù ưĂŏĂ .(Qihua,2006) Ŧùþþ!ƒĂ Ŧ!ĂnjʅĜ!Ŧ IJþZ Ƙƒƨŏďž Ă 2ƑĜUĂ Ǉďžư Ŧ5ĬƙPďž!ƒ ŦŏʅþǉnJ!ƒ .Ŧŏηďžƨƶ!ƒ ǉŖNj ŦnjηƒĂ (1)ýŦT!ƒ



.(Proteus) ΣĂŏƙĂƧƶ Ŧŏηďžƨƶ ŦnjηƒĂ :(1)ýŦT!ƒ

(Lab View) Ăŏ5 ƳŬ Ŀŏŋďž2ŀ-2

ĿŀďžĠŢ!ƒ ƘƒĂþŪƒ Ƨ5ĂƘ Ŀŏơ Ŏƪþŀǌ!ƒ ĎŏďžƬƘ!ƒ Ŏ5 ĎžþƤƘƪŏ ƘĠŏŋďž2ŀ ĎžĠŬǉ ŎŇǌ Ăŏ5 ƳŬ

ĿƑŏŀ Ƨ5ĂƘ ŎŇǌĂ ŬýŏŀþƘpĂ Ŏ5Ă ĎžĿơƘ!ƒĂ ƩĠŏl!ƒ ƧƒƒĂþ ýĂďž ŎƪþŀǌŊ ƽŏŀƱƘ ĬD ĈĠŀǌ! ɯĠƘơǉ ŎƘ!ƒ

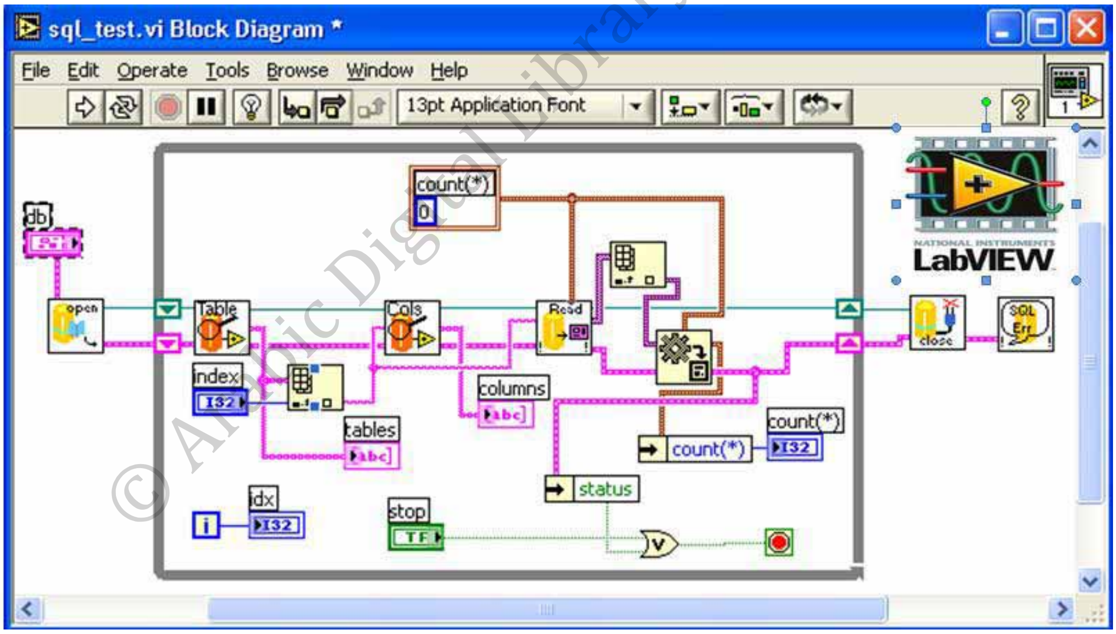
ƖĂp ǇŏŀyďžŊ!ƒ ǇĐ Ġďž‡ .ŊƑĠƘǉ!ƒ Ŏ5 ĿþþĂ Ŀ!ƑĠ5 ĿƵƧƪ Ǉďžư ƻĠŢƘ‡ŬƒĂ ƧĠ‡ƘŀúĀ ƧŏĂƱƘ! Ŀŏ!ĠĂďž

ĎŏďžƬƘ!ƒ Ŏ5 þŏƒƨƘďž!ƒ þŏlƶƘ!ƒ ĬŀƵ ƳŀƺƘ!ƒ Ǉďž Ǉ‡ďžŏ Ŀŏlŏlơ ƖƨǌŋĐĂ ƘƒþơĂ ĈĠŀǌ ydž Ŀŏŋďž2ŀ!ƒ ǉŖǌ

ĿŏŀďžƵ!ƒ ƘĠlŏŀƱƘ!ƒ Ǉďž Ƨŏλ‡!ƒ Ŏ5 ĎžþƤƘƪƘ Ŀŏŋďž2ŀ!ƒ ǉŖǌ ǇĐ Ĭ!ƒ Ŀ5Ġư ŬĠŀ ŬýĠďž!ƒĂ þǌŋ!ƒ Ƨŏ5ĂƘĂ

(Johnson, Ý ƧĂƬ!ƒĂ Ăŏþŏ5!ƒ ƘƒƨŏďžŀĿďžĂƵþďž!ƒ ƘĠlŏŀƱƘ!ƒ Ŏ5 þƵĠƪƘ! ǗưŏĐ Ƙďžďž Ƭ þl5

.Ŀŏŋďž2ŀ!ƒ ǉŖǌ! ĎžþƤƘƪďž!ƒ ĿǌŋƒĂ ƠưĂŏ (2)ý‡Ţ!ƒĂ 1997 Truchard, 2013).



.(Lab View) Ăŏ5 ƳŬ Ŀŏŋďž2ŀ ĿǌŋƒĂ :(2)ý‡Ţ!ƒ

(Crocodile) ýŏƒþĂ‡ĂƧ‡ Ŀŏŋďž2ŀ -3

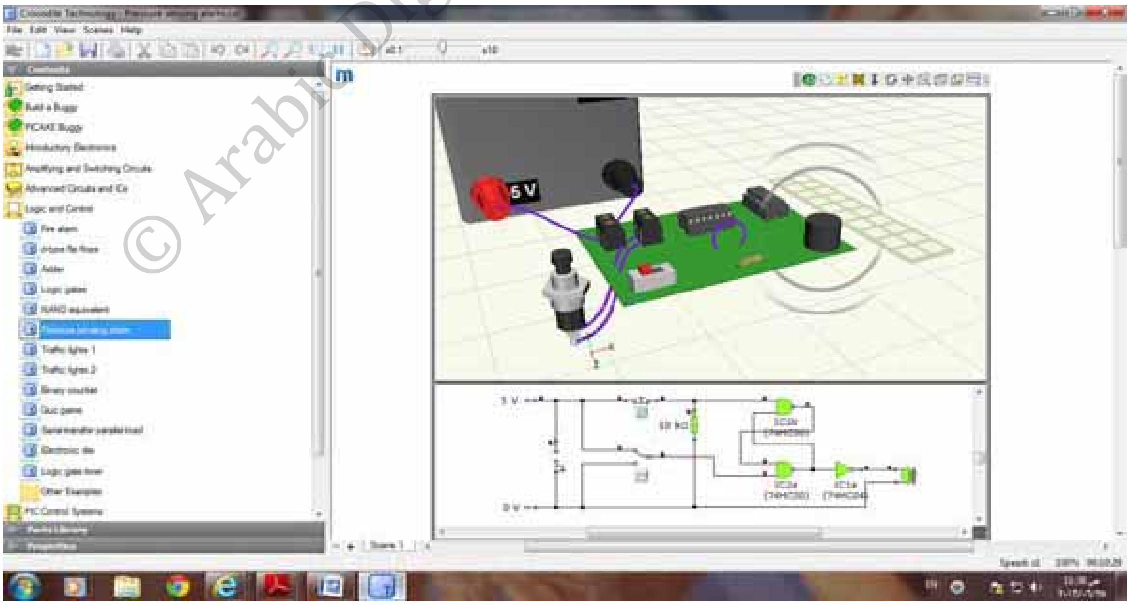
Ŏ5 Ŀŏŀďžƶ!ƒ ƘĠŏǉĂƧƘ‡!Ŭƒ ƩŏƨþƘ Ŏ5 ƖþŏƵ ƘƒĂǉƪ Ĭưďžŀ ĬŖ!ƒ Ʃƨþďž!ƒ Ǉƒ ŬyþƒĂ!ƒ Ŏ5

ƧƒƒĂþ!ƒ Ŀ5Ġ‡ ĬŀƵ Ǐ!Ŗŀ ĎžĠŏl!ƒ Ŏ5 Ƨŏ‡5Ƙ!ƒ ŊŏŀƵ ƳƵƬ!ƒ Ǉďž ŬĿŏlŏlơ Ŀŏơ ƘĠǉĂ‡ďž ĎžƒþƤƘƪĠŀ ƧŀƘƤďž!ƒ

ŬĿ5ŀƘƤďž!ƒ ƧƒƒĂþ! ƳƪĠǉďž ƖĠ‡Ġơďž ŊďžĠǉƧŀ ĬŀƵ ƽŏŀƱƘ! ǇĂƧŏλ‡!ƒ ƋŋŀŎ Ǐ!Ŗ! ŬĿƵĂǉƘďž!ƒ ĿŏǉĂƧƘ‡!Ŭƒ

ýdžz!ƒ ýǖP LJdž Ŏkdŏ ïŖ!ƒ Džžzk!ƒ LJdž Ɣʅk‡dž!ƒ Džnj5!ƒĂ ïƥơk!ƒĂ ƟǴŏkƧŰƒ ǴnjLjdž ƔǴƅʅD lƥz! ǁ!ŖĂ lƥƑǴ5!ƒĂ ȠƑǴkLj!ƒ LJdž Ǵ ư Ƨ!ƒ ĬžZ ýĂƬơ!ƒĂ ǕŁŏždž!ƒ ý‡ǴTdž!ƒ ýơ ĬžZ Ŏždž!ƒ ƔŏƧƥk!ƒĂ ǴǴLjƅ!ƒ ýŏƒƥĂ‡ĂƧ‡ ŁŏƞdžƧƅ‡ ŎlŏlƠ!ƒ ýƥƒĂ!ƒ LJdž ǽƥƞ ŁƅŏƧƥ lǴ‡ǴƠdž ȠdžƒƧƅ ǁǴLjȠ ƘƧnjǓ ǁ!Ŗ! ǕlƧǴǙŰƒĂ .(Avison, 1998)

ýùƛdž ŁùŽĂljkdž ƘŰǴƞdž Ŏ5 ŁŏƞdžƧƅ!ƒ ljŖȠ ƘdžƥƤkʅ ƥl5 ŁŏƑǴƅƧnj‡!ƒ ƧƒĂƥ!ƒ Ĭ!ƒ Ł5Ǵ ư ŰǴƅ ƧùƱƤ LJĂƥƅ ŁŏƑǴdžŏ‡ ŁƅƧƞk ïŰ lǴ‡ǴƠdž ýdžŽ Ǵnj!ǖP LJdž Džžzdž! LJ‡dž ŁŏơǕǴǴdžŏ‡!ƒ ƘƒƧƅkƤdž Ɣù!ǴƱ!ƒ ýŏƱkʅŏ ŁŏơǕƧŏ!Ǵ‡k LJĂƥƅĂ ŁƅǕƱ!ƒ ĬžZ lƧƱƤ LJĂ‡k ƥƥ ŁŏžZ5 ƥƒĂdž DžƒƥƤkʅƒ LJĂƥƅĂ Ƙƒƨùž5!ƒ ýùdž ĂD Ưzƅù!ƒ Ǵnj ư ùzƅ ýdž ƯǴdžơŰƒĂ ƥŽƒĂ!ƒ ƘŭŽǴ5k LJdž ƥŏƥz!ƒ Ŗŏ5ljkĂ DžŏdžƬk DžƒƥƤkùʅƒ LJdž ƩƧƥdž!ƒ LJ‡džk ŁžZǴ5 ŁŏƞĂ!ĂLj‡k lƒƥD ǴnjLjĂ‡ LJdž‡k ǴnjkŏdžȠnj5 ǕǴnjkǴ‡ǴơdžĂ ƘǴLjĂƅƧ‡!ƒĂ ƘǴdžnjdž! ŁzkdžƆ!ƒ LJdž ǻzƅǴƱ Ŏ5 ư k ǴȠƧĂƥƅ Ŏk!ƒĂ ǕŁŏ5Ƭ!ƒ Ł5ƧƷ!ƒ ýƤƒƥ lƥŽǴʅdž lƒƥƌ‡ ǴŏƞĂ!ĂLj‡k!ƒ .ŁŏƞdžƧƅ!ƒ ljŖȠ ŁnjƞƒĂ (3)ý‡T!ƒ Ơ ư ĂŏĂ .(Dinevski, 2012) Ɣ!ǴƱž! ƩƧƥdž!ƒ ǴnjdžƥlŏŎk!ƒ



(Crocodile) ýŏƒƥĂ‡ĂƧ‡ ŁŏƞdžƧƅ ŁnjƞƒĂ :(3)ý‡T!ƒ

(Electronics workbench) ţ ĻĴŀ ǁ ƨĂĂ Σ ŧöĻĵĂƨķŧ!ƒ ŀönďžƨŀ -4

Ŀödžpƨ!ƒ) ĿöƑĜŀƨnjŧ!ƒ ĿdžUĻŪƒĂ Ŀöʅþĺnj!ƒ ƘĜȚ ȚPķ!ƒ ǇĴdž þöþz!ƒ Ŏ5 Ŀönďžƨŀ!ƒ ĺjŖNj ĎžþPķʅƙ

ĺþĜdž Ŏ5 Ŀö!ƨĺjdž!ƒ ƘĜŀnƒĂ!ƒ ǁ!ŖŧĂ Ŀö5Ț!ƒ ƘĜƱĜTĺj!ƒ ĎžZþ! ĜnjdžƒþPķʅƒ ǇŧdžöĂ Ü(ĿöƨUĜĺjķ!ƒĂ

ÇĜĻĴŀ ǇĴdž Ɣ!ĜƱ!ƒ ǇŧdžķŎķ!ƒ Ƙŭ5ŰƒĂ ƔơȘ!ƒ ĺƨödž ĎžþPķʅdž!ƒ ĿnjnƒĂ ƨ5Ăƙ Ŀöơ ÜƘĜöĺjĂƨķŧ!Űƒ

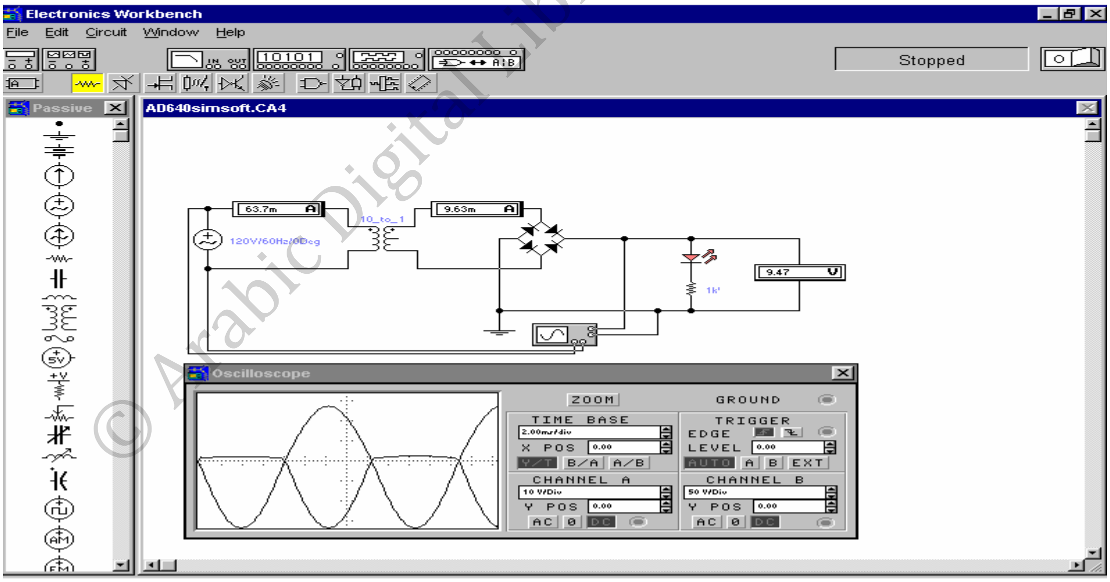
ĺĜŧĜơdž!ƒ ƨĂdžƨ ĬĺlZ ƨĺĻj!ƒĂ ÜŎƑĜŀƨnjŧ!ƒ ƨĜökk!ƒ Ă þnjn!ƒ ýƛdž ΣĜöl!ƒ ĺƨnjnƉ ɯƒƨþɋĂ ƨƒƒĂþ!ƒ

Ŀöơ Ü(4) ýŧT!ƒ Ŏ5 ƠưĂdž ĂNj Ĝdžŧ ĿơĂl!ƒ ĬĺlZ ƨĂ5!ƒ ĬĺlZ ĿưĂƨzdž!ƒ ǋƑĜķĺj!ƒ ĿödƧ! ƨƒƒĂþl!

ǽưöƉ Ŀönďžƨŀ!ƒ ĺjŖNj ĺƨþĺdž Ŏ5Ă ÜŎĺöĺơ!ƒ ĿöĻĵĂƨķŧ!Űƒ ŀʅþĺnj!ƒ ƨŀķPdž ÿþƒĂ!ƒ Ŏ5 ŎŧĜơķ ĜnjĻjƉ

Ďžödž Țķŀ Ǌ5öĺŧķ ýűP ǇĴdž ĺþöþn ĎžöǊĜ5dž ƔĜʅķŧƒ ǇĴdž Ɣ!ĜƱ!ƒ ǇŧdžķŎnj5 Ďžĺzķ!ƒ ĿöĺdžZ Ŏ5 ĺþZĜʅdž!ƒ

.(Doering, 1997؛ Jian, 2003) ǋƑĜķĺj!ƒ ǇĴdž ƽĺơķ!ƒĂ ýöĺơķ!ƒ ÇƒƨnƹĂ ĿöĺdžZ Ŀö!ƨĺjdž ƘĜŀnƒĂ



(Electronics workbench) ţ ĻĴŀ ǁ ƨĂĂ Σ ŧöĻĵĂƨķŧ!ƒ Ŀönďžƨŀ ĿnjnƒĂ :(4)ýŧT!ƒ

(Pspice) Σ öĜŀʅ Ŏŀ Ŀönďžƨŀ -5

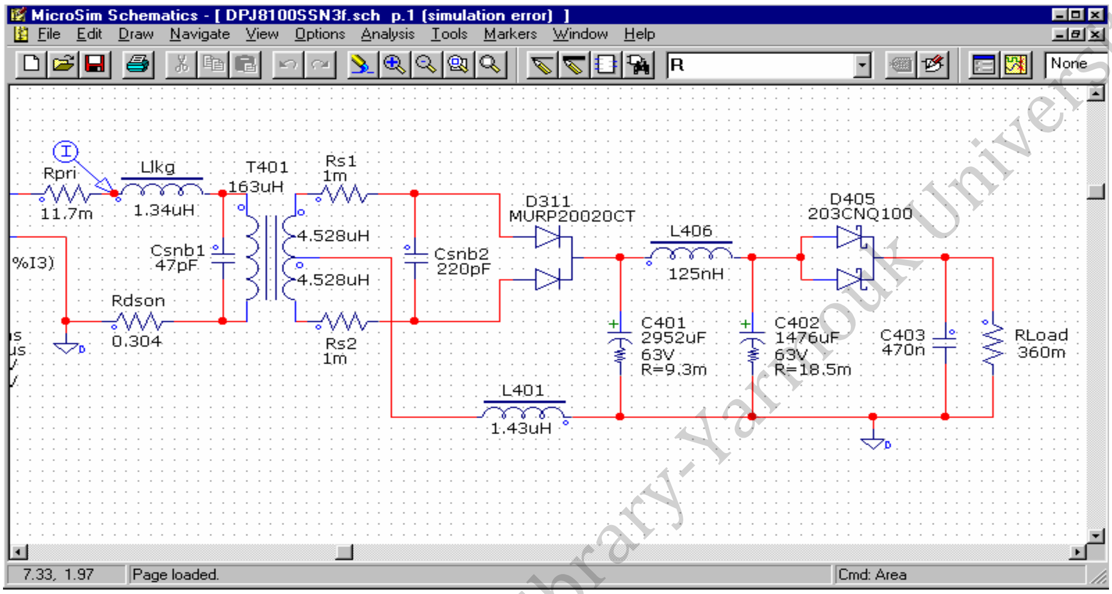
ǇĴdž þöþz!ƒ Ŏ5 ǽưöƉ Ǌö!Ĝz5ŀ ƨĜķdžķ Ŀönďžƨŀ!ƒ ĺjŖNj ǇĜ5 Ŀ5ĂƨzdžĺƒƘƒƨödž! Ŀ5Ĝ ưŮĜŀ

ĿöĻĵĂƨķŧ!Űƒ ƨƒƒĂþ!ƒ ƳƒĂĻjƉ ǇĴdž þöþz!ƒ Ĭ!ƒ ĜnjlöŀƱķ þķdžö Ŀöơ Üŧdžþĺķdžƒŀöʅþĺnj!ƒ ƘĜlöŀƱķ!ƒ

& Hoang Desai, (Ŀö!Ĝz!ƒ Ƙƒþþƨķ!ƒ ƘƒŖ ƘĜnĂdž!ƒ Ŏ5Ă ĿöķĂȚ!ƒ ƽĂ5Ă ĿöƑĂư!Ĝŧ

Zhengqio, Nowicki,1999; & Lypacewicz, Tortoli Maione, ; , 1993 Sonek .2005)

.ƗǒƞǆƧƕ!ƒ ǉǭǊ ƗǌƞƒǍ ƠƯǍǒ (5)ýǂT!ƒǍ



(Pspice) ƩǒǄƕƪ Ǒƕ ƗǒƞǆƧƕ ƗǌƞƒǍ :(5)ýǂT!ƒ

(Simulink) ǁǉǒ! ǍǒǆƪǍ ƗǒƞǆƧƕ -6

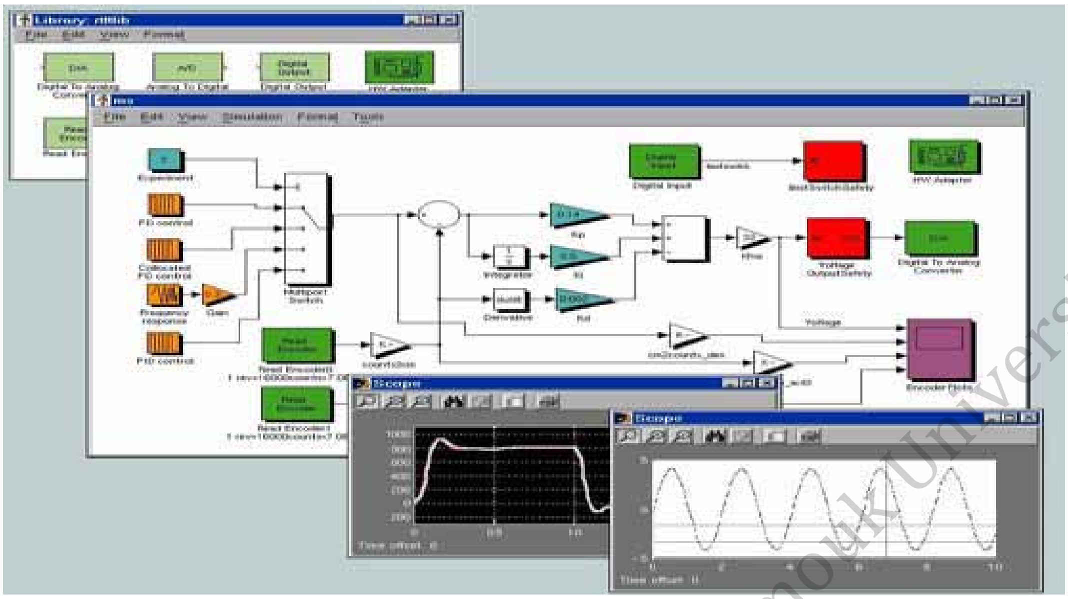
ǑǊ ýƕ ƖǄǂǄƠǆ ƗǒƞǆƧƕ ƱƖ5 ƘƪǒǍ - (6)ýǂT!ƒ Ǒ5 ƠƯǍǆ ǍǊ ǄǆǂǍ - ǁǉǒ! ǍǒǆƪǍ

ƖƥƑƪ ƘƠƕƬƊ ƥƥǍ ǗýǆǄǂ!Ǆƕ ƜǬǍǆǉ ǅǄǉƕ ǏǁƵ ǆǄǄǉ!ƒ ǅǒǆƬƘ!ƒ ǇǆǇǂǆƙ ǇǂǆƙǆǄǂƙǆ ƘƒǍƥƊ ƗƵǍǆƞǆ

ƥǒƥƠƙ ǇǂǆǒǄǍǉ!ǔP ǇǆǒƘ!ƒǍ ǗǆƥƞƗǉǆǓƒ ƘƒƧǄƱ!ƒǍ ƘƒƧǄƪ!ƒ ƘǄƵǄǉƬ Ǒ5 ǏƘƠ Ɨ5ǍƧƵǍ

ǄǄǉƕ!ƒ Ǒ5 ƳǍƧT!ƒǍ ǑǁƵ5!ƒ ǬǒƖǉǆ!ƒ ýƕƥ ǄǄƱPǓƒ ǉǭǊ ƗƞƪǄǆǍ ǅǒǆǄƬƘ!ƒ ǄǄƱPǓ Ɨǁǆƙƛǆ!ƒ ƧƥǄƬǆ!ƒ

.2004)& Caspi, , Maraninchi, Tripakis, Sofronis(Scaife



(Simulink) ǁǉǧ! ǍǒǆǕ ǂǒǕǄǑǆǍǍ ǂǉǈǇǍ :(6)ýǂT!ǎ

(Multisim) ǃǕǒǉǃǆ ǂǒǕǄǑǆǍ -7

ÜƘƒþùƶǆ!ƒ ƻùǆǂǍ ǃþùǂ!ƒ ýǆǆ ǂǒǆǆƶ!ƒ ƔƧǂƞǂ!ƒ ƩǒƧþǂ ýǂƞǆ Ǒ5 ǂǆƑǂ!ƒ ýǂǂTǆ!ƒ Ɣǂǂǂ

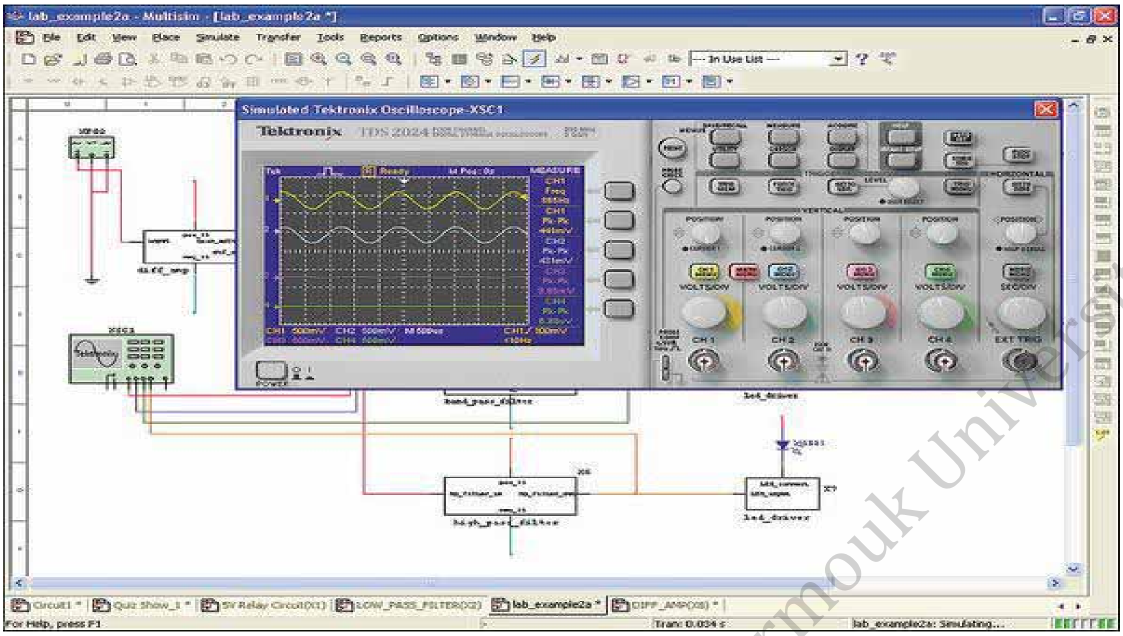
ƧùƑƒǍþ Ǒù5Ǎ Ǐù!ǍǕƒ ǂƞƧþ!ƒ ǈǆ ƘǂƠƬƧǆ!ƒ ƧƑƒǍþ Ǒ5 ǂƬǂP ǀƧǂǂǂ ǂǒƞǆƧǂ!ƒ ǉƦǈ ƘǆþPǂǂƒ

ǉƦùǈ ǊƑǂùǂǉ ǈǒùǂǂ ǂùǒƠ ÜǂǉƬùƑǂƬPǍ ǂǉ5ƑǂUǍ Ɣǂǂǂ ǁ!ƦǍ ǂǒƧUǂǉǂ!ƒ ƧƑƒǍþ!ƒ Ǒ5Ǎ ǃǒPưǂ!ƒ

ǊƑǂùǂǉ ƯƧùƵ Ǒ5 Ʊǀ5 Ʃǒ! ÜǂǒǂƵ ǂǒǂƵ5 ǑƱƶǒ ƩǒƧþǂ!ƒ Ǒ5 ƔǍǂǂǂ ǂǉǆƒþPǂǂƒ ǈǂ ǂǒƞǆƧǂ!ƒ

ÜƧùǒǂǂ þơ Ǐ!ǫ ƩǒƧþǂ!ƒ ǀǂǂ5ǂ ǈǒǂƠǂǍ ǃǒǂƶǂ!ƒ ƻǒ!ǂǂǂ ýǒǂǂ Ǒ5 ǂưǒǂ ǈǂ!Ǎ ÜƨǒþþýǂTǂ ǀǂǂƠǆ!ƒ

.(Liping, 2009) ǂǒƞǆƧǂ!ƒ ǉƦǈ ǃƒþPǂǂǂ ǑǀǒƱǂ ýǂǆ (7) ýǂT!ƒ ƠưǍǒǍ



(Multisim) ĎĩǿķĩǆŢŏŋǆ2ǁ ŦnjŋƒĂ :(7)ý‡T!ƒ

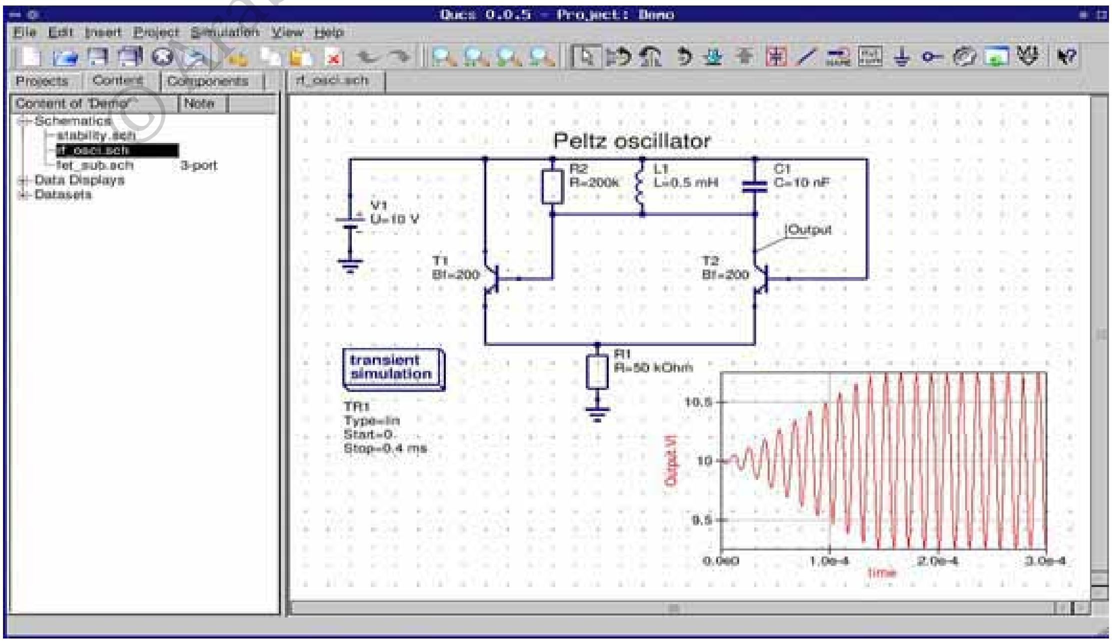
(GNU) Ăŏ LJĐ Ŏŋ Ţŏŋǆ2ǁ - 8

Ţĩþǈ ýǆT!ķ! ĸĜŏǁʊķ!ƒ Ŏ5 ĜNjþƒþķǆĜǁ ƨĜķǆķ ĜnjǈĂ‡ Ŏ5 LJǆ‡ķ! Ţŏŋǆ2ǁ!ƒ ǉŘNj Ţŏ!Ĝz5 þƒþƨķ

LJŏǿķ Ĝnj!ŭP LJǆ ĎķŎ!Ă ŨNƑĜķǉ!ƒ Ţþþ LJǆ Ţŏ!ĜZ ɣǈǁ ŢŏĂŏþƒ2!ƒ Ţŏ‡ǈĜǁ!ƒ ĸĜŋĂǆ!Ĝ‡ ĸŬĜȚķŬƒ

Ŏ5 ƠưĂǆ ĂNj Ĝǆ‡ Ĝnj!ĜʊZĐ ɣĜǁǈĐ Ţ5ƨzǆ Ŏ5Ă ŢǆþPķǈǆ!ƒ ĸŬĜȚķŬƒ ǈƨnjŋĐ

.(Valentin, Malm & Karl , 2006) (8)ý‡T!ƒ



(GNU) Ăŏ LJĐ Ŏŋ Ţŏŋǆ2ǁ ŦnjŋƒĂ :(8)ý‡T!ƒ

(KtechLab) ƔǖǂǒǨ Ǒǂ ǂǒŋǛƵǛ -9

ǴǌǒǛƵ ǶǛƵ ǐ ƦƎ ǗǇǍǨ ǂǴ ƥǒǒƥ ǶǛ ǇǛ ƖƵǛ ǶǍǕ ƘƶƜǍ ǴǛ ǴƵǍǇ ǂǍƥơ ǂǒŋǛƵǛ ǑǊ

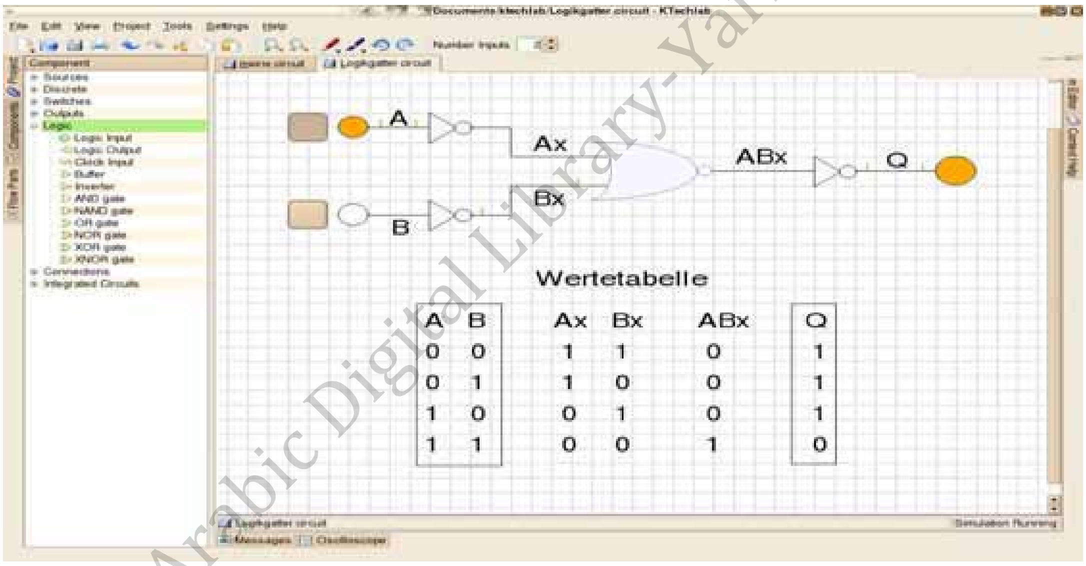
ǛǍ ǂǒǴơ ǂǒŋǛƵǛ ǇƦǊ ƘǴǒǛƱǨ ǇǛ ƵǒǍǂ ǛǒǛƮǨ Ǒ5 ǇƵǴǂ5 ƵǒǍƱǨ ǛǨ ƥǍ .2007 ǛǴƵ ǏǨơ

ǂǒǇǍƵǨǂǗ ǂǒƥǇǌ ƵǍǍƥ ǇǴǂǴơǍ ǛǒǛƮǨ Ǒ5 ǛƥƤǨ ǂǒơ .2009 ǛǴƵ ǴǌƮǒƤƵǨ ǛǨ

Ǒ5 Ƕ ǂƱǒ ƵǍǍƥ Ǒ5 Ʊ5 Σǒ ǴƜǒ ƘǛƥƤǨ ǴǛǂǍ ǗǂǒƥƘǴŋǴƵǛ Ǒ5 ǂƮǴƤǍ

ǂǒŋǛƵǛ ǇƦǊ ǂǌŋǍ ƠƜǍǒ (9)ǶǂƬǍ .ǴǊƵǒƩǍ ƘƵǴǒ ǂƵǴǇƮǂ ǂǒƵǴǇƮ ǂƥǇǌ ƘǗǴŋǛ

, Lucas & Padrah,2011).Alonzotg(



(KtechLab) ƔǖǂǒǨ Ǒǂ ǂǒŋǛƵǛ ǂǌŋǍ :(9)ǶǂƬǍ

(Circuit Maker) ƵǂǒǛ Ƙǂƶǒ ǂǒŋǛƵǛ -10

ǛǒǊǴǛǍ ƔǴǨǂ ǇǛ ǂǛƱǍ ǇǒǂǛǨ ǑƜǍƵǨǗǍ ƵǨƤǛǍ Ǒ5 ǂǒŋǛƵǛǍ ǇƦǊ ǛǍƥƤǨ Ƨ ƥǊ

ǂǒơ ǗǂǒǇǍƵǂǗǍ ǂƥǇǌǍ ǶǴŋǛ Ǒ5 ǂǒǛƵǍ ƘǍƵǴǌǛǍ ƥǴǇǍ ƵǒǂǨǍ ƘǍƵǴǌǛǍ ǂǒƥǇǌǍ

ƘǴǇǂǛǍ ƯƵ Ǒ ǛƵ ǶǂƬ ǂƥƵǍ ƒǴƮƤǍ ǏǛƵ ǂǒƥǍ Ǒ5 ƔǴƱǍ Ƨ ƵǨǒ

ǇƵǌŋ ǛǍƥƤǨ ǂǒǂǍ ǂǒǇǍƵǂǗǍ ƵǍǍƥ ƱƵǍ ƇǴǇ ǂǒǂ ǛǍ ǂǂǨƤǛǍ ǂǒƥǴƥǗǍ ǂǒǇǍƵǂǗǍ

ǴnjƙǴǀŏǁƠƙ Ǐǁǁž 2ƧzƙǃfĂ ǴŏǁǁǆŽ ƧffĂƥǃf ǉŖǋ ǅƒƥƤƙƪƒ Ɨŏƽŏǂ ÜǴnjzǆǆ ýǆǆǴzƙǃfĂ ƩǴŏǃfĂ ƒ ơƽǃf

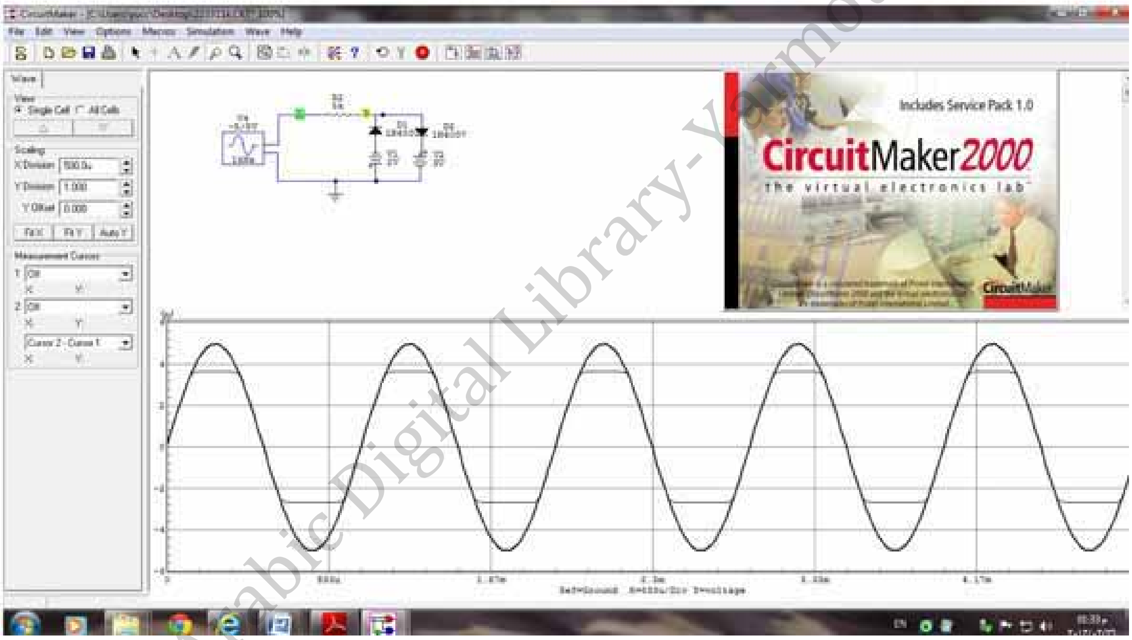
ƨǴnjŋǂ ƗŏƧƕƤǆǃf ǀƨnjŋŪf ýǆǆ ýǆǆǴzƙǃfĂ Ɨŏƽŏǂ Ă ÜƔĂǴǉƙǆǃfĂ ƘƕǴǍǃf ƧǴŏƙǃf ƧffĂƥ ƔƧǴŋƙ Ŏ5

ǨƤǆĂ ýǴƠŹŪf ƒ ŏƤTƙ Ɨŏƽŏǂ ǆǆĂ ÜǀƧǴTŬf ƥǃĂǆǆ ƨǴnjŋĂ (ƔĂǂƪĂǁǁŏƪĂŬf) ǀƧǴTŬf ǆǆƪfƧ

Ǐǁǁž 2Ƨzƙ ƥƥ Ǐ!ĂŪf Ɨŏzǆǆǆŋǃf Ɨǁǁơƨǆǆǃf Ɣ!ǴƠ ǈĂǂŏ fǨnjƕĂ ǋfǴƙǉǃf ǖfƧƤƙƪǫĂ ƘfƇfƧǃf

ÜŎǁǁǆǆz!f ýƥfĂǁǁ! ƭƧŏĂǂ ýĂǴǆǆǆǆ ýǂTƕĂ ƘǴŏǉĂƧƙǂǃf Ʃƥǉnjǆǂ ǴnjŋǴƙơŏ Ŏƙ!f Ɨŏƪƪ ǴŪf ƇǏƥǴƕǆǆ!f

.ýǴĂǆǆ ýǆǆ Ɨŏŋǆǆƨƕ!f ƗnjfĂ (10) ý ǂT!f ƠưĂŏĂ



(Circuit Maker) ƧǂŏǆǆƘǂƧŏƪ Ɨŏŋǆǆƨƕ ƗnjŋĂ :(10)ýǂT!f

ǉŖǋ Ŏ5 ǴnjǀŏǁƠƙ ǆǆƙŏ! ǀƧ5ĂƙǆǆǃfƘǴŏŋǆǆƨƕǃf ǈǆǆ ƥŏƥz!f ǈŏƕ ǈǆǆ Ɨŏŋǆǆƨƕǃf ǉŖǋ ƧǴŏƙƤƒ ǆǆƙ ƥǀ!

Ŏǁǁŏơƪ!fĂ (2008)ƧŏŽƨ!f ǈǆǆ ýǂ Ǵnjŏ!f ƧǴTD ǴǆǆǂǀƥŽƘfƨŏǆǆƕ Ɨŏŋǆǆƨƕǃf ǉŖǋ ƨǴǉǆǆƙ ǂŏơ ƗƪfƧƥǃf

:Ƙfƨŏǆǆ!f ǉŖǋ ǈǆǆĂ (2008)

.ƇfƧƕƤ!f ƠǀƼ ƩŏǃĂ ƗǁǁƠǃf ǈǆǆ ǈŏfƥǉǆǆǁǁ! Ǐƙơ ƾŏǁƠƙǃfĂ ǆǆǁǁzƙǃf Ŏ5 Ɨ!ĂnjƪǃF -1

.ýŏǅTǁǁ! ƭƥŋ ƧŏȚƥĂ ŎƪǴŏƥ ǈǆǆƨ ǉǴƙơƙ ǂŏơ ǋfǴƙǉǃf ƇǴƠŽǫ Ŏ5 ƗŽƧƪǃf -2

.Ŏǁǁǆz!f ýƥfĂǁǁ! ƭƥŋ ƗƕƧǴǀǆǆ ƗŋƧƥƕ ǋfǴƙǉǃf ƇǴƠŽƒ Ŏ5 Ɨƥƥ!f -3

4- [illegible]

5- [illegible]

6- [illegible]

7- [illegible]

8- [illegible]

9- [illegible]

10- [illegible]

[illegible]

11- [illegible]

12- [illegible]

[illegible]

[illegible]

[illegible] (Mosterman *et al*, 1994) [illegible]

[illegible]

(72) [illegible]

[illegible]

[illegible]

[illegible]

[illegible] (Gokhale, 1996) [illegible]

[illegible] (ILLinois State University)

[illegible]

[illegible] (16) [illegible] (16) [illegible]

[illegible]

[illegible] (Bell & Fogler, 1999) [illegible]

[illegible] (27) [illegible]

[illegible]

[illegible] (Grima & Teruel, 2000) [illegible]

[illegible] (500) [illegible]

[illegible]

[illegible] (Harms, 2000) [illegible]

[illegible]

1. [illegible]

2. [illegible]

3. [illegible]

4. [illegible]

5. [illegible]

[illegible] (Chi *et al*, 2001) [illegible]

[illegible]

(Drofinik, Kolar, Duijsen & Bauer, [illegible]

[illegible] 2001)

[illegible] HTML [illegible]

[illegible]

(2002)

(66)

(Change, 2002)

8

(156)

(138)

[illegible]

[illegible] (Hung, 2003) [illegible]

[illegible]

[illegible] (Cordel & Meinel, 2004) [illegible]

[illegible]

[illegible]

[illegible] (Jensen, Voigt, Nejdl & Olbrich, 2004) [illegible]

[illegible]

[illegible] (Balmush & Dumbraveanu, 2005) [illegible]

[illegible] (200) [illegible]

[illegible]

[illegible]

[illegible] (Postlethwaite, Pocock & Dutton, [illegible]

[illegible] (115) [illegible] 2005)

[illegible] (49) [illegible] (66) [illegible]

[illegible]

[illegible] (Feisel, 2005) [illegible]

[illegible]

[illegible]

[illegible] (Saànchez *et al*, 2005) [illegible]

[illegible] (Matlab & Simulink) [illegible]

[illegible] (GUI) [illegible]

[illegible]

[illegible] .

[illegible] (Keller & Keller, 2005) [illegible]

[illegible]

[illegible] (2005) [illegible]

[illegible] (25) [illegible]

(25) [illegible]

(Zacharia, 2007)

(88)

(43) (45)

(Dillon, 2007)

(14)

1.54

& Evripides, (Athanasios, Dimitris,

2012).

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] 2005 [illegible]

؛ Chi *et al*, 2001 ؛ Postlethwaite, *et al*, 2005 ؛ Hung, 2003 ؛2002 [illegible]

[illegible] .(Zacharia, 2007 ؛ Drofinik *et al*, 2001

[illegible]

(Mosterman *et al*, .(1994 [illegible]

[illegible]

[illegible]

[illegible]

(Keller & Keller, 2005 ؛ [illegible]

Saànchez *et al*, 2005 ؛ Balmush & Dumbraveanu, 2005 ؛Change, 2002

.(Gokhale, 1996 ؛ Athanasios, *et al*, 2012

(Dillon, 2007 ؛ Feisel, 2005 ؛ [illegible]

[illegible] Cordel & Meinel, 2004 ؛ Bell&Fogler, 1999)

[illegible]

[illegible]

[illegible] .

[illegible] (Harms, 2000) [illegible]

[illegible]

[illegible] (Jensen *et al*, 2004) [illegible]

[illegible]

.(Chi *et al*, 2001 ؛ Grima & Teruel, 2000) [illegible]

[illegible]

[illegible]

الفصل الثالث

الطريقة والإجراءات

[illegible]

[illegible]

[illegible] Experimental Design [illegible]

[illegible] (2 × 2) [illegible]

(Pre- Post Test Control Group Design)

Random		*Pre*	*Exp.*	*Post*
R	E	Y1	X	Y2
R	C	Y1	-	Y2

[illegible]:

[illegible] .(Controlled Group) [illegible] (Experimental Group) [illegible]

[illegible]

[illegible]

[illegible] .([illegible]) [illegible]

[illegible] .(Y1 & Y2) [illegible]

[illegible]

.[illegible]

[illegible]

[illegible]

[illegible] (1) [illegible]

[illegible] 2013 /2012 [illegible]

[illegible] (134)[illegible] (135) [illegible] (269) [illegible] (13)[illegible]

[illegible] (1) [illegible]

.[illegible]

ţ ŢǬĦǁČŇǰ Ƨ ǼǁǁĦǁ ƒyǴĦ ƕ ƨ ƐƥǫǁƐ ǗĎŽĦǁĎŽ ƕǴĦǗ ǫƐǫYƈ ǗĬŖŇǰĦ .1 üŇǰǫǁǁƐ

ǫǫyǁƐ	ţ ŢǬĦǁƐ	ǫǫyǁƐ	Ƨ ǼǁǁƐ
101	(ĶŬǴŢķŬƒĂ ĶǴŏǰĂƧķĦ!Ǖƒ) Ď	135	ƧĂĦŖ
168	(ĦŏƕƱ!ƒĂ ăĂl!ƒĂ üĶǴƕ ƪǴơ!ƒ) Ɣ	134	Ħ ǴǰĎ
269		269	YĂďžƞďž!ƒ

ƕ ƨ Ɛƥǫǁ Ɛ ƕďžĬY

ĭ ĂǴùƞơ!ƒ Ħùŏǁ Ħ Ŏ5 ĦŏǰĂƧķĦ!Ǖƒ Ħƪƥǰǌ!ƒ Ħƕǁ Ʊ ǇďžƔ žŢ yƕƧĎ ǇďžĦƪƒƧƥ!ƒ ĦǰŏƵ ĶǰĂĦķ

ƔžŢùǁ! ŎƑƒĂŢž!ƒ ǇŎŏžķ!ƒ Ďžķ ƥpĂ ÜĦƱŏƪƕ!ƒ ĦŏƑƒĂŢž!ƒ ĦlŏƧƱ!Ǵƕ ǴǈƧǴŏķƤƒ Ďžķ ÜĦŏƞĂ!ĂǰĦķ!ƒ Ħƪƥǰǌǁ!

Ŏ5 ǇŎķŏƕŏƧƞķ ǇŎķƕžŢĂ ŎǰǴĂ!ƒ ýŢ5!ƒ Ŏ5 ǇŎķƱƕǴư ǇŎķƕžŢ Ĭ!ǫ ŎƪƒƧƥ!ƒ ĎžǴž!ƒ Σ5ǰ Ŏ5 ǰƧǴķƤďž!ƒ

Ħùƪƥǰǌǁ! ĭ ĂǴùƞơ!ƒ Ħŏǁ Ħ Ŏ5 lƥĂƞĂďž!ƒ ĦƪďžƤ!ƒ ĶǴŢ ŢƤķ!ƒ Ħ5ǴĦ ýĂďžŢ Ďžķ Ǵďž Ħ .Ŏ5ŏŢ!ƒ ýŢ5!ƒ

Ħùƪƥǰ ǇǰĂ ÜĶǴƕùƪǴơ!ƒ Ħùƪƥǰ ǇǰĂ ÜĶŬǴŢķŬƒ Ħƪƥǰ ǇǰĂ ÜĶǴŏǰĂƧķĦ!Ǖƒ Ħƪƥǰ Ǉǰ) :ŎǇǰĂ ĦŏƞĂ!ĂǰĦķ!ƒ

(Ď) ƒ ŢùƤķ!ƒ :ǴďžǇǰ ǇŎƪŏƑƧ ǇŎŢ ŢƤķ Ĭ!ƒ ĶǴŢ ŢƤķ!ƒ ǰŖǇǰ Ďžŏƪlķ ĎžĂ Ü(ĦŏƕƱ!ƒ Ħƪƥǰǌ!ƒĂ ăĂl!ƒ

ÜĦŏƪƒƧƥ!ƒ ĦƱƤ!ƒ Ŏ5 ǇŎŢ ŢƤķ!ƒ ǇŎŖǇǰ ǇƕǴŢķ! (ĶŬǴŢķŬƒ Ħƪƥǰ ǇǰĂ ĶǴŏǰĂƧķĦ!Ǖƒ Ħƪƥǰ Ǉǰ) :Ďž ư ŏĂ

Ħùƪƥǰǌ!ƒ ĂùǇǰ ĦŏǰĂƧķĦ!Ǖƒ Ħƪƥǰǌ!ƒ Ŏ5 ƧƤǰ ƧƕķƤďž ĦƪƒƧƥ ǴďžǌǰǰĎž ƔǁƱķŏ ǇŎŢ Ţķ!ƒ ǇŎŖǇǰ ǇĂĦĂ

ăĂùl!ƒ Ħùƪƥǰ ǇǰĂ ĶǴƕƪǴơ!ƒ Ħƪƥǰ Ǉǰ) :ĶǴŢ ŢƤķ!ƒ ŎpǴƕ Ďž ư ŏ (Ɣ) ƒ ŢƤķ!ƒĂ Ü(2) ĦŏǰĂƧķĦ!Ǖƒ

ÜƧĂùĦŖ) ĦùŏƕŏƧƞķ ĦùƵĂďžƞďž : Ĭǁ Ƶ lƧǴķƤďž!ƒ ƔžŢ!ƒ ĦƵĂďžƞďž ĶĂķơƒ ƥpĂ ..(ĦŏƕƱ!ƒ Ħƪƥǰǌ!ƒĂ

ƧǴùŏķƤƒ Ďžùķ .(Ɣ Ü Ď ƒ ŢƤķ!ƒĂ Ħ ǴǰĎĂ ÜƧĂĦŖ) ĦƱƕǴư ĦƵĂďžƞďžĂ (Ɣ Ü Ď ƒ ŢƤķ!ƒĂ Ħ ǴǰƒĂ

ƧƑƒĂƥ) ŎǇǰĂ Σ ŏƧƥķǁ! (1) ĦŏǰĂƧķĦ!Ǖƒ Ħƪƥǰǌ!ƒ ƧƕķƤďž ƧƧlďž Ŏ5 lƥĂƞĂďž!ƒ ƔƧǴƞķ!ƒ ǇďžĦƵĂďžƞďž

ƧùƕķƤďž!ƒ Ďžƒ ƥƤķƪǴƕ ĦŏƕŏƧƞķ!ƒ ĦƵĂďžƞďž!ƒ Ħƕǁ Ʊ Ķƪ Ƨƥ Ħŏơ Ü(ĎžŏƤ ư ķ!ƒĂ ÜĎžŏĂlķ!ƒ Üƽŏǁžķ!ƒ Ü ƒ l!ƒ

Ķùƪ ƧƥĂ Ü(Circuit Maker) ƧùĦŏďž ĶĦƧŏƪ!ƒ lƧǴķƤďž!ƒ Ħŏďžŏǁžķ!ƒ ĦŏƞďžƧƕ!ƒ Ǉďž ư Ŏ ư ƒƧķ5Ǖƒ

Ĭ!ǫ ĦƪƒƧƥ!ƒ ĦǰŏƵ yŏƨĂķ ǇŎƕŏ (2) ýĂƥƞ!ƒĂ Ü ĭ ƥŏǁlķ!ƒ ƧƕķƤďž!ƒ Ďžƒ ƥƤķƪǴƕ ĦƱƕǴ ư !ƒ ĦƵĂďžƞďž!ƒ Ħƕǁ Ʊ

. ƒ ŢƤķ!ƒĂ Σǰƞ!ƒĂ Σ ŏƧƥķ!ƒ ĦlŏƧƱ! ǴžƕķǴǌķǴƵĂďžƞďž

[illegible] .2 [illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	21	[illegible]	26	[illegible]	21	[illegible]	21	[illegible]
	23	[illegible]	18	[illegible]	23	[illegible]	23	[illegible]
88			44				44	[illegible]

[illegible]

[illegible]

[illegible]

[illegible] (Circuit Maker) [illegible]

ƨƼŕƤƽ!ƒ ƚŀőƨƱƼ ƓnjƽőƽƬƙ ƊƙŽ ƔƨƓŋƙ!ƒ ǈƽ ƚƽƨơ ƴƽƙ! ƚƪƅnjǈ!ƒ ƚőŀƚ ƚƼƱ! ƚőǈĂƨƙƚ!Ǖƒ

.ƚőƽőŀƨƙ!ƒ ƸƒƅNJǕƒ ƽőŀơƙĂ ƟĂưĂ!ƒĂ ƚ!Ănjƪ!ƒ ƨƬƓǈƸ ǏŀƸ ƚŀƽƙƬƽ ƚơƓƼ!ƒ ýƼƿ ǈƽ ƠưƒƨƙƽǕƒ

ǏƬƐƅƚƷǕƐ ƅƓƚƗƽŀƐ ƨǏƅƚ ƼǏƸǏ ĂƚƳ ƊƗƨƅƽŀƐ ƒǏƅƚ

ƚőƽőŀƨƙ!ƒ ƚőƞƽƨƼ!ƒ) Ɵưƒƨƙƽǔƒ ƨƼŕƤƽ!ƒ ƊƒƅƤƙƪƓƼ ƚƼƱ!ƒ Ʃőƨƥƙ ƚőŀƽƸƼ ƔĂƨƬ!ƒ ýƼƿ

ƊƒƅƤƙƪƒ ƚőƽőƚ ǏŀƸ ǕƦőƽŀƙ!ƒ ǏŀƸ ǈőƽƑƓ!ƒĂ ǈőƚƨƓƬƽ!ƒ ǕǈőƪƨƥƽƼ!ƒ ƔőƨƥƘ ǈƽ ƅƼ Ǖ ǈƓƚ (ƖƨƓƙƤƽ!ƒ

ƊƓƽ!ǔƒ ǈƽ ƊnjƼ! ƅƼ ǕĂ ƚŀőƨƱ!ƒ ǉƦǋ ƟƓƞǈƒ Ɵ5 ýƓƸ5Ă ƊnjƓƪƽ ƨƬǈƸ ƊnjǈƤ ƚőơ ƚőƞƽƨƼ!ƒ ǉƦǋ

ƚőƼőƨƥƙ!ƒ ƚőŀƽƸ!ƒ ƚŀơƨƽŀ! ƊǈƅƒƸƒĂ ƊnjƼőƨƥƙ ƚőŀƽƸ ƘǈƓƚ5 ǕƽőƼƱƙ!Ɠ ƇƅƼ!ƒ ýƼƿ ƚŀƽƓƚ ƓnjƙƒĂƱƤƼ

ƚő!ƒ ǏŀƸĂ Ǖƚƪƒƨƥ!ƒ ƸƒƅNJƿ ƽőŀơƙ ǏŀƸ ƘŀƽƸ ƨƬƓǈƸ!ƒ ǈƽ ƚƸĂƽƞƽ ƘǈƽưƘ ƟƙƒĂ ƩƓƪǕƒ

ƚŀơƨƽ ŀ!Ʀ ƅƸƼ Ɵƙƅƙ! ǕƓnjƽƒƅƤƙƪƒ ƖƨƓnjƽ ƔƓƪƚƒ ƚƞƨƅ Ǐ!ƒ ƚƼƱ!ƓƼ ýĂƬĂŀ! ƦőƽǈƙƸ!ƒ ýơƒƨƽĂ

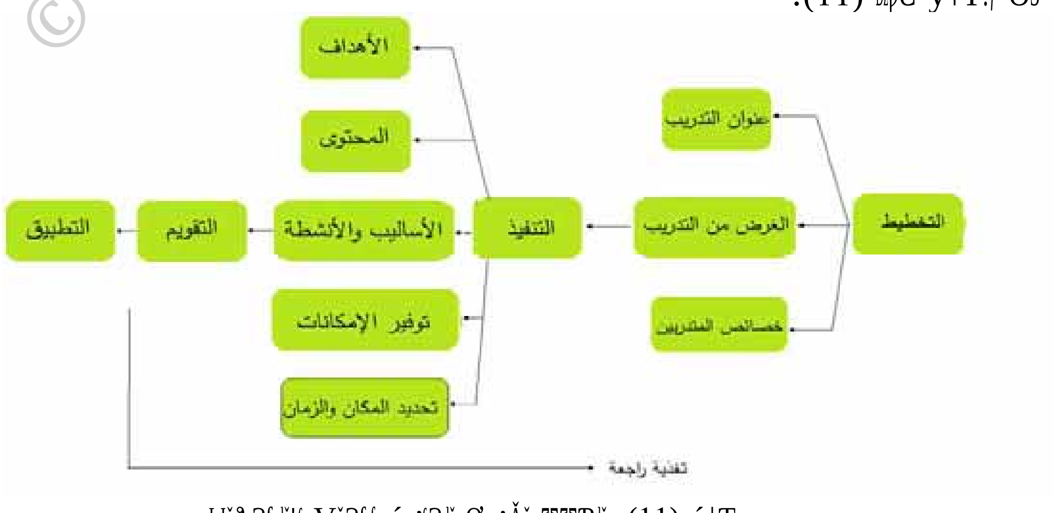
ƚŀƽƸƙƽ!ƒ ýƞƒƨƽ!ƒ Ơƨƚ ƚƸƞƒƨƽƚ ƚơƓƼ!ƒ ƊƒƅƤ ƅƤĂ .Ɵưƒƨƙƽǔƒ ƨƼŕƤƽ!ƒ ƊƒƅƤƙƪƓƼ ƚƼƱ!ƒ Ʃőƨƥƙ

ǕƚőơƓ!ƒ) :ƘƓƪƒƨƥ!ƒ ǉƦǋ ǈƽĂ ǕƩőƨƥƙ!ƒĂ ƔőƨƥƙƒƸ ƘƒƒƨƱ ǏŀƸ ƔŏƱǕƒ ƠƨƷƼ ýƓƞƽ!ƒ ƒƦǈƼ

Ă (2003Ǖ ǏĂŏƙƵ!ƒ) Ǖ(2003ǕƅƞǈƤ ƠƓŏƨ ƚƪƪƽ) Ǖ(1993ǕƟƸƨƽ)Ǖ(2011ǕƱőƱƿ) Ǖ(2003

Ɠƽƚ ǈőƪƨƥƽƼ!ƒ ƔőƨƥƙƒƟ!ƓƙƒƱƱƤƽ!ƒ ýőƤ ǈƽ ƚơƓƼ!ƒ ƸƚƱǈƤ ƅƤĂ .(1998 ǕƟƽƓƱƤĂ Ɵƽƙƿ)

.(11) ƊƤƨ ýƚƙ!ƒ Ɵ5



LJőƪƨƥƽ!ƒ ƔőƨƥƘ ýơƒƨƽ ƠưĂő ƱƱƤƽ :(11) ýŧT

1 -

2 -

.(Laird, 1997)

(2008

.(2008

3 -

(1987

- [illegible].

- [illegible]

[illegible].

[illegible] (3) [illegible].

[illegible] .3 [illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	20	[illegible]	1	
[illegible]	18	[illegible]	2	[illegible]
[illegible]	3	[illegible]	3	[illegible]
[illegible]	2	[illegible]	4	
[illegible]	18	[illegible]	1	
[illegible]	5	[illegible]	2	[illegible]
[illegible]	2	[illegible]	3	[illegible]

[illegible] (3) [illegible] (10.75 [illegible]) [illegible] (8.33 [illegible]) [illegible].

[illegible]

[illegible]

[illegible]

1. [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]

2. [illegible]

[illegible]

[illegible] (1995 [illegible]) [illegible]

[illegible]

.3

.4

(Circuit

Maker) (data show)

.5

[illegible] (4) [illegible]

[illegible]

[illegible] .4 [illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] 2013/6/2	1:30	[illegible]	1
[illegible]	[illegible] 2013/6/3	1:30	[illegible]	2
[illegible]	2013/6/4 [illegible]	1:30	[illegible]	3
[illegible]	[illegible] 2013/6/5	2:30	[illegible]	4

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] (1) [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] (1) [illegible]

[illegible]

- [illegible]

- [illegible]

- [illegible]

- [illegible]

[illegible]

- [illegible] (1) [illegible]

.2013/2012

Ƙǘőƥƶƙ!ƒ ƇƒƧƞǫǍ ǄǏnjƙǴƱơǘǆ ǏǇƵ ƳǘƱǗƒ ǄƙǍ ǗLJőƪƧƥǆ!ƒ LJǆ ƥƥƵ ǏǇƵ ǄőǊǤǆ!ƒ ƯƧƵ ǄƙƙƖ -

(2) ƽơǇǆ Ǒ5 ǤǆƗ ƗőƨőǇƞǈǗƒǍ ƗőǊƧƶ!ƒ LJőƙƺǇ!Ǥ ǗƗőǞǤnjǈ!ƒ ǤnjƙƧǍƮ ǄőǊǤǆ!ƒ ƗǆǞǤƿ ƦƤǆƙ! Ɨǆƨǘ!ƒ

.(3) ƽơǇǆ Ǒ5Ǎ

ƔƪơƖ (4) ƽơǇǆ Ǒ5 ǤǆƗ ƗőǆǇƶ!ƒ ǄőǊǤǆ!ƒ ƔǴƪƙƗƪ ƧǤƙƤǤ ƗƮǴƤ ƘǤƮƒǍǆ ƗǆǞǤƿ ƥƒƥƵǫ Ǆƙ -

:ƗőƙǓƒ ƘƒǍƱƤ!ƒ

.ǤnjƧǤőƙƤƪ Ǆƙ Ǒƙ!ƒ ƔƧǤƞƙ! - ƗƪƒƧƥ!Ǥ Ɨǈǆ ƯƙǆǇ!ƒ ǑǆőǇƶƙ!ƒ ýƮƽ!ƒ ƔƧǤƞƙ ƘǴƵǍƯǍǆ ƥőƥơƙ .1

ýǴƞǆ!ƒ ƘǴőǍƙƪǆ ǏǇƵ ǤnjƶőƨǍƙǍ ƧƧǀǆ!ƒ Ǒ5 LJǆƯƙǆ ƳǍƯǍǆ ý!ǂ Ɨő5Ƨƶǆ!ƒ ƻƒƥǊǗƒ ƥőƥơƙ .2

.(ǄőǍǀƙ ǗƔőǂƧƙ ǗýőǇơƙ ǗƽőǊƱƙ ǗǄnj5 ǗƧƗƦƙ) ǄǍǇǊ ƻőǉƮƙ ƔƪơƖ Ǒ5Ƨƶǆ!ƒ

ýǘƤ LJǆ Ǒ5Ƨƶǆ!ƒ ýǴƞǆ!ƒ ƘǴőǍƙƪǆ LJǆ ǎǍƙƪǆ ýƗ Ǒ5 ƻƒƥǊǘ! ǑǊƪǈ!ƒ LJƨǍ!ƒ ƥőƥơƙ .3

:ƗőƙǓƒ ƗƿǘƶƖƒ

$$\frac{\text{ǎǍƙƪǆ!ƒ ƻƒƥǊǄ ƥƥƵ}}{\text{ƻƒƥǊǘ! ǑǇƗ!ƒ ƳǍǆƞǆ!ƒ}} \times 100\% = \frac{\text{ýƗ Ǒ5 ƻƒƥǊǘ! ǑǊƪǈ!ƒ LJƨǍ!ƒ}}{\text{ǎǍƙƪǆ}}$$

ƗőƪƒƧƥ!ƒ ƗǈƪƖƒ ǎǍƙƪǆǍ ƗǊǤƞǗƒ LJǆƨǍ ƗǇƑƪǗƒ ƳǍǈ ƔƪơƖ ƧǤƙƤǗƒ ƗǇƑƪǗ ǑǇƗ!ƒ ƥƥƶ!ƒ ƥőƥơƙ .4

.Ɣ!ǤƱǇ!

& Beasley, 2004 ;(Bogart ƘƒƧǤƙƤǗƒǍ ƴƿƒǍǆ!ƒǍ ƴƞƒƧǆ!ƒ LJǆ ƥƥƵ ǏǇƵ ƳǘƱǗƒ Ǆƙ .5

ƗőǞǤƧnjƗ!ƒ ƧƑƒǍƥ!ƒ ƘǴƵǍƯǍǆǊ ƱǉƙƧƙ ƗǇƑƪǄ ǆƯƙ Ǒƙ!ƒ Ghausi, 1985; Savant, 1991).

. ƧǤƙƤǗƒ ƘƒƧǀ5 ƥƒƥƵǫ ƥǈƵ ǤnjǊ ƗǈǤƶƙƪǗƒǍ Ɨ5ǇƙƤǆ ƘǴőǍƙƪǆ LJǆǍ ǈƧǤƙƤǆ!ƒ ƗőǈǍƧƙƗ!ƑǍ

ǗǀƥùőƞǇ!ƒ ƗƹǴőƮù!ƒ ǀǴùƵƒƧǆ yǆ ǗƘǤƮƒǍǆ!ƒ ƗơǞǗ ƽ5Ǎ ƧǤƙƤǗƒ ƘƒƧǀ5 ƥƥƵ yƯǍ Ǆƙ

LJƒƨǍǕƒ ƇǍùƯ Ǒù5 ƗőƪƒƧƥ!ƒ ǀƥǤǆ!ƒ ǎǍơǆ Ǒ5 ƗǇƑƪǕƒ ǊǑ5 ƳƨǍƙƙ ƧǤƙƤǗ LJƨƒǍƙǆ!ƒ ƥƒƵǓƒǍ

ǊƙƧǍƮǊ ƧǤƙƤǗƒ LJǍƗƙǍ ǗǤǆǊƥőƥơƙ Ǆƙ LJǑƦǇ!ƒ ƻƥnj!ƒ ǎǍƙƪǆǍ ǎǍơǆ!ƒ LJǆ ýƗ! ǀƥƥơǆ!ƒ ƗőǊƪǇ!ƒ

[illegible] (27) [illegible] (40) [illegible]

[illegible] (13) [illegible]

[illegible] (5) [illegible]

[illegible] .5 [illegible]

[illegible]	[illegible]	[illegible]	[illegible]
%35	14	31,26,22,21,20,19,18,17,9,10,6,4,3,1	[illegible]
%28	11	40,39,38,29,23,16,12,11,8,5,2	[illegible]
%22	9	37,36,35,34,33,32,25,24,7	[illegible]
%15	6	30,28,27,15,14,13	[illegible]
-	-	-	[illegible]
-	-	-	[illegible]
%100	40		[illegible]

[illegible]

[illegible]

[illegible] (1) [illegible]

[illegible]

[illegible] .6 [illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0.45	0.56	**21**	0.55	0.35	**1**
0.42	0.64	**22**	0.51	0.46	**2**
0.43	0.52	**23**	0.42	0.70	**3**
0.42	0.27	**24**	0.60	0.46	**4**
0.45	0.56	**25**	0.45	0.58	**5**
34	0.45	26	0.44	0.54	**6**
35	0.46	27	0.42	0.68	**7**
0.54	0.28	28	0.42	0.72	**8**
0.45	0.56	29	0.51	0.54	**9**
0.48	0.66	30	0.55	0.35	**10**
0.60	0.68	31	0.51	0.46	**11**
0.43	0.60	32	0.42	0.70	**12**
0.51	0.46	33	0.60	0.46	**13**
0.42	0.45	34	0.45	0.58	**14**
0.44	0.70	35	0.46	0.56	**15**
0.44	0.54	36	0.53	0.48	**16**
0.42	0.68	37	0.42	0.45	**17**
0.42	0.70	38	0.44	0.70	**18**
0.60	0.46	39	0.48	0.29	**19**
0.45	0.58	40	0.47	0.28	**20**

[illegible] (6) [illegible] (0.72 [illegible] 0.28) [illegible] (0.60 [illegible] 0.42) [illegible] (2005 [illegible] (40) [illegible].

[illegible]

[illegible] (Test-Retest) [illegible] (40) [illegible] (Cronbach α) [illegible] (0.85) [illegible]

[illegible] (0.82) [illegible]

[illegible]

(Crocker and Algina, 1986 [illegible] 2005 [illegible]) [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] (55) [illegible]

[illegible]

[illegible]

(7) [illegible]

[illegible] (8) [illegible]

[illegible]

.(9) [illegible]

[illegible]

.(10) [illegible]

[illegible]

[illegible]

[illegible] .(40) [illegible]

.(11) [illegible]

-2 [illegible]

[illegible]

-3 [illegible]

[illegible]

-4 [illegible]

[illegible]

-5 [illegible]

[illegible]

[illegible] 2006 [illegible] (Watson and Glaser, 2002) [illegible] (2005) [illegible] (2000 [illegible] (x & z) [illegible] .(Facione, 1998) [illegible]

(Anderson, 1994) ǕǰǍƔƧƥǕǊ ƗƔƒƧƥ ƴǆǅ ƽ5ƒǍƙö ƒƘǊǍ ƗöǕǍƧƙƗ!Ǚƒ ƗƔƥǕǋ!ƒ ǖƥǅǅ Ŏ5 ƒ ƬƤƙǅ

.ƗƬ ƬƤǆ!ƒ ǖƥǅ!ƒ Ŏ5 ƥpǅ!ƒ Ƨöƚƙ!ƒ ǏǍƵ ǖƧƥ!!ƒ ƠöơƬ ýƚƬǃ Σölƙ ǖƒƥǊ ƧöǍƱƙ ǖƧǍƧư ǃ

ýùƚ Σöùlƙ Ŏùƙ!ƒ ƘƒƧùlƽ!ƒǍ ƗǏƒùƔǙƒ ǕǅǆǅǍ ƥöƥz!ƒ ǕǅǅưƘ ǏƦ!ƒ ƧǅƘƤǙƒ ƗơǅǕ!ƒ ƥƵǊǍ

ǕǊ ƧǅùƘƤǙƒ ƥƒƥùƵƺ ƥùǕƵ ŎùƵǍƧ ƥùpǍ ǙƗùö!ǅơ!ƒ ƗƔƒƧƥ!! ǅǃƔ ǖƥƥơǅǅ!ƒ ƘƒƧǅǆǅ!ƒ ǕǅǅǅǍ ǖƧǅǆǅ

ƘùƤǊ ǅùǅǍ ƗǏƒùƔǙƒ ǕƘùǊ ƗùzöǅƱ ƽƙƙ ƗöơǙƥƥzƙǅǅ ǕǅǅǅƧǅƘƤǙƒ ƗǏƒƔǊ YǍǕ ǕǅǅǅǊƙƒƥƧƽǅǅ ǕǍƚƙ

ƗùƵǍǅƞǅ Ǐùǅ ƧǅùƘƤǙƒ ƯƧùƵ ǅùƙ ǙƥùpǅǕ!ƒ Ƨöƚƙ!ƒ ƘƒƧǅǆǅ Σǅöl! ǅöǕƧǍƽö!ǅƚ ƧǅƘƤƒ ǊǃǍ

ƧǅùƘƤƒ ƘǅƽùƬƒǍǅ (7) ýǍƥùƞ!ƒ ǕǃùöǍ .(12) ƽùơǅǅ!ƒ ƒ ǅƬùƙƤǙƒ ǏǍƘ ǕǍùǅƚơǅ!ƒ ǕǅǅǅǕ

.ƗƔƒƧƥ!ƒ ǕƘǊ ƯƒƧƺǙ ƥzǅ!ƒ ƥpǅǕ!ƒ Ƨöƚƙ!ƒ

.ǃƨƐƥǕǅǅƐ ǕƤǊǅǅ ǅǆƵǅǅƐ ǅƽƒǅǅƐ ƥĭǀƸǅǅƐ ƥƒǅƗǅǆ ǖƒƸƬƐǊǅ .7 ǖǊǅǅǅ

ǃǏƚǀǀƐ ǃǅƥǅǅƐ	ǃǏǅƨǅǅƐ ǅǅƘǊǙƐ	ǅǅY ǖƐƥƽƸǅƐ	ǖƐƥƽƸǅƐ !ƒƽƥǅ	ǅƽƒǅǅƐ ƥĭǀƸǅǅƐ ǖƐƥƒǊǅǅ	
4	%20	4	4-1	ǖƒƬƐƥƗƺǙƐ ǃƺƥƴǅ	1
4	%20	4	8-5	ƥĭƨƸǅǅƐ	2
4	%20	4	12-9	ƗƒƗǅƗƨǗƐ	3
4	%20	4	16-13	üĭƚƟƗǅƐ	4
4	%20	4	20-17	!ĭĭƽƗǅƐ	5
20	%100	20		ƱǊǅǅǅǅƐ	

ǅƽƒǅǅƐ ƥĭǀƸǅǅƐ ƥƒǅƗǅǆ ƼǅƬ .ǅ

ǙƨööǅƙǅƒǍ ƗǃǍzƬ!ƒ ƘǕǅǅƺzǅ ǅƒƧƤƙƔƒǍ ǙƗöƵǕƱƙƔǙƒ ƗǅözǍƒ ǏǍƵ ƧǅƘƤǙƒ ƽöǃƱƙ ǅƙ

ǅƥƵǍ Ǚ(0.20) ǕǅǅǅýpǊ ǍǊ (0.85) ǕǅǅǅƧλƚǊ ƗǃǍzƬ ýǅǅƺzǅ ƘƒƘ ƘƒƧlƽ ǁ!ǅǍǊ ǕǍƚö ǅ! ǊǕǊ ƥƞǍ

ƨööǅƙ!ƒǍ ƗǃǍzƬ!ƒ ƘǕǅǅƺzǅ (8) ýǍƥƞ!ƒ ǕǃǃöǍ ǙýpǊ ǍǊ (0.20) ƨööǅƙ ýǅǅƺzǅ ƘƒƘ ƘƒƧlƽ ƥǍƞǍ

.ƧǅƘƤǙƒ ƘƒƧlƽ!

[illegible] **.8** [illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0.53	0.48	**11**	0.59	0.52	**1**
0.48	0.48	**12**	0.45	0.72	**2**
0.45	0.28	**13**	0.48	0.60	**3**
0.44	0.29	**14**	0.49	0.29	**4**
0.47	0.54	**15**	0.45	0.60	**5**
0.45	0.56	**16**	0.44	0.52	**6**
0.47	0.30	**17**	0.54	0.68	**7**
0.45	0.70	**18**	0.44	0.71	**8**
0.44	0.58	**19**	0.51	0.68	**9**
0.44	0.56	**20**	0.58	0.64	**10**

[illegible] (8) [illegible] (0.72 [illegible] 0.29) [illegible] (0.59 [illegible] 0.45) [illegible] (Crocker & Algina, 1986 [illegible] 2005 [illegible]) [illegible] (20) [illegible] (9) [illegible].

[illegible] **.9** [illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					1	[illegible]
				1	0.53	[illegible]
			1	.0.74	0.38	[illegible]
		1	0.56	0.72	.0.55	[illegible]
	1	0.81	0.55	0.65	0.67	[illegible]
1	0.84	0.87	0.77	0.86	0.65	[illegible]

Ƨŏǂƽƙǃƒ ƧǴƕƙƤƒ ǇǊŏƕ ǂďŭƶǃǴƕ ǂƮǴƤǃƒ ƟǴƕƙƧŬƒ Ƙŭďǖƶď ĎŏƥǇ Ǉǋ (9)ýĂƥƞǃƒ ǇǊď ƲơŭŏĂ

ƟǴƕƙƧŬƒ Ƙŭďǖƶď ĎŏƥƘơĂƒƧƙ ǁǃƦǂĂ (0.87- 0.65) ǇǊŏƕ ƘơĂƒƧƙ ƥƥ ǋƙƧǴǌďĂ ƥƥǴǈǃƒ

ǴŏƑǴƮơƍ ǂǃƒƥĂ ǂǃĂƕǀď Ďŏƥ ǴǌǈǇĂ (0.81- 0.38) ƘƒƧǴǌďǃƒ ǇǊŏƕ ǂďŭƶǃǴƕ ǂƮǴƤǃƒ

.(2005ÜǀƥĂƵ)

ơƽƑďǁǁ ƥĭǀƻǁǁ ƥƑǴǂơƐ ǀƑǴƙ .ơ

ǀƥǴƵŰƒ ƘǴƕǍĂ ŎǐƤƒƥǃƒ ƨǴƪƙŬƒ ƘǴƕǍ ƧŏƥǀƙýŭƤ ǇǊď ƧǴƕƙƤŬƒ ƘǴƕǍ ǇǊď ƨǀơƙǃƒ Ďƙ

ƩǁƕÜǴǌƙǈŏƵ ƜƧǴƤ ǇǊďĂ ǂƪƒƧƥǃƒ ýďƙƞď ǇǊď ǂŏƵŭƟƙƪŬƒ ǂǈŏƶǃƒ ǏǁƵ ǋǀŏƕƟƙ ýŭƤ ǇǊď ƧǴƕƙƤŭǃ

Ü(Test-Retest) ƧǴƕƙƤŬƒ ǀƥǴƵƍĂ ƧǴƕƙƤŬƒ ǂǀŏƧƟ ĎƒƥƤƙƪǴƕ ÜǂƕǃǴƟĂ ǴƕǃǴƟ (40) ǴǋƥƥƵ

ǇǊŏƕ ŎǐƤƒƥǃƒ ƨǴƪƙŬƒ ƘǴƕǍ ƧŏƥǀƙĂ ÜŎǈǴǍǃƒĂ ýĂŪƒ ǇǊŏǀŏƕƟƙǃƒ ǇǊŏ ǇǊŏƵĂƕƪǇ ǈƧƒƥǀď Ŏǈďƶ ƨƧǴƽƕ

Ü (0.84) ǋƙďŏƥ ƘǈǴǂ ƥƥĂ (Cronbach α) Ǵƽǃǅ ƠǴǈǈĂƧǂ ǂǃƥǴƶď ĎƒƥƤƙƪǴƕ ƧǴƕƙƤŬƒ ƘƒƧǀƽ

ƑǋǋƕĂ Ü(0.89) ǋƙƥǴƵƍĂ ƧǴƕƙƤŬǴƕ (ǇĂƪƧŏƕ ƟǴƕƙƧƒ ýďǴƶď) ƧƒƧǀƙƪŬƒ ƘǴƕǍ ýďǴƶď ƩǁƕǇŏơ Ŏƽ

Ŏƽ ƧǴƕƙƤŬƒ ƥǴďƙƵƒ ƯƒƧƩŨ ǂŏƽǴǂ ƥƶƙ ƧǴƕƙƤŭǃ ǀƥǴƵŰƒ ƘǴƕǍĂ ŎǐƤƒƥǃƒ ƨǴƪƙŬƒ ƘǴƕǍ Ďŏƥ ǇǴƽ

ƘǴƕǍ Ƙŭďǖƶď Ďŏƥ (10)ýĂƥƞǃƒ ǇǊŏƕŏĂ .(2005 ÜǀƥĂƵ) ǂƪƒƧƥǃƒ ǂǈŏƵ ǏǁƵ ŎƑǴǌǈǃƒ ƨŏƕƟƙǃƒ

.ǋƙƧǴǌď ǇǊď ýǂǃĂ ǋƙƥǴƵƒĂ ƧǴƕƙƤŬƒ ƘǴƕǍ ƘŭďǴƶďĂ ŎǐƤƒƥǃƒ ƨǴƪƙŬƒ

ǋƙƧǴǌď ǇǊď ýǂǃĂ ǋƙƥǴƵƒĂ ƧǴƕƙƤŬƒ ƘǴƕǍ ƘŭďǴƶďĂ ŎǐƤƒƥǃƒ ƨǴƪƙŬƒ ƘǴƕǍ Ƙŭďǖƶď Ďŏƥ .10ýĂƥƞ

ƘƒƧǀƽǃƒ ƥƥƵ	ǀƥǴƵŰƒ ƘǴƕǍ	ŎǐƤƒƥǃƒ ƨǴƪƙŬƒ	ƥƥǴǈǃƒ ƧŏǂƽƙǃƒƘƒƧǴǌď
4	0.95	0.56	ǀƑƮƐƥǂƷŰƐ ƕƷƥýǅ
4	0.81	0.58	ƥĭƨƻǁǁ
4	0.91	0.57	ǂƑǂďǂƨŰƐ
4	0.88	0.67	üǐǂƟǁǁ
4	0.86	0.55	ǃĭĭƨǂǁǁ
20	0.89	0.84	ŎǂǃǃƒƥƥǴǈǃƒ Ƨŏǂƽƙǃƒ

[illegible]

[illegible] (60) [illegible]

[illegible]

[illegible]

[illegible] (13)

[illegible] (14) [illegible]

[illegible]

[illegible] (15).

[illegible]

[illegible] (16).

[illegible]

[illegible] (20). [illegible]

[illegible] (17).

hŭǂDžyǁƐ lƐþƑNJDžǁƐ ƒƑƨƗǀŰ hưƟǘDžǁƐ hƽƑƲƓ :ƑyƓƐþ

hŭǂDžyǁƐ lƐþƑNJDžǁƐ ƒƑƨƗǀƐ Ǐƺ hưƟǘDžǁƐ ƧƑĭƨDž ƀƑdžƓ -ƉD

ƾǒƧƱ LJƵǍ ÜƇƒþǕƒ ăǍƙƪdž DžǒǍlƙ! ƗdžƨǕǍ ƗǒƧǍƧư ƗǒǁdžƵ ƗǒǁdžƶƵ!ƒ ƘƒƧƓnjdž!ƒ ƩƓǒp LJƒ

Ü(2007 ÜþƜƓƵ) ƇƒþǕƒ Ǒ5 ƧǍƮl!ƒ ǍD ƟƓƞǉ!ƒ ăǍƙƪdž þǒþơƙǍ ƗƼƧƶdž yǒƱƙƪǉ ƩƓǒl!ƒ ƗǒǁdžƵ

ƩǒƧþƙ ƾǒƧƱ LJƵ ƗǁƮơdž!ƒ ƗǒǁdžƶƵ!ƒ ƗǒdžǁƶƵ!ƒ ƘƒƧƓnjdžǁ! ǑƑƒþǕƒ ƔǉƓƞ!ƒ Ǒ5 lƧƓnjdž!ƒ ƩƓǒp LJǂdžǒǍ

.ƧƛǕƒ ƗǉƧƓldžǍ ƗǒƜǒƧƞƙ!ƒǍ ƗǒþƓǒƙƵǕƒ LJǒƙlǒƧƱ!ƓƜ ƧƜƙƤdž!ƒ

ƩdžƤƜ ƗƜǍǁƱdž!ƒ ƗǒǁdžƶƵ!ƒ Ɨǒƪþǉnj!ƒ ƘƒƧƓnjdž!ƒ Ƙþþơ Ɨǒơ ÜƗƲơǕdž!ƒ ƗpƓƱƜ þƒþƵƒ Džƙ

ƗƸƓǒƮƜ ƗơƓƜ!ƒ DžƓp Džƛ ÜƗǒƵƧƼ!ƒ ƘƒƧƓnjdž!ƒ LJdž ƺþþƵ lƧƓnjdž ýǂ LJƵ ƘƵƧƼƙ DžƛƗƪǒƑƧ ƘƒƧƓnjdž

Ü LJǂdžƙdž) lƧƓƶƜ ƓnjǉƓlƙǫ DžþƵ LJdž ƓnjǉƓlƙǫ Ǐ!ǫ lƧƓƬŰƒǍ ÜlƧƓnjdž ýǂ ýƛdžƙ Ǒƙ!ƒ ƗƜǍǁƱdž!ƒ ƘƒƧƓƶǁ!

:ǑNj ƗǒǁdžƶƵ!ƒ ƘƒƧƓnjdž!ƒ ǉǨNjǍ ÜƘƓƲơǕdž!ƒ ýƞƪ Ǒ5 ƓnjǉǒǍþƙǍ (LJǂdžƙdž ƧǒƸ

þǒþơƙǍ lƨnjƞǕƒ ƧƓǒƙƤƒ LJdž Ɣ!ƓƱ!ƒ LJǂdžƙ ýƛdž :ƗƜƪƓǉdž!ƒ lƨnjƞǕƒǍ yƱl!ƒ ƧƓǒƙƤƒ lƧƓnjdž -

.ƓnjdžǒpǍ ƗƜǍǁƱdž!ƒ yƱl!ƒ YǍǉ

ƇƓǉƜ LJdž LJǂdžƙ!ƒ DžưƙǍ ÜƗǒǉǍƧƙǂ!ƒýƒ ƧƑƒǍþ!ƒ ƇƓǉƜǍ ƔǒǂƧƙǍ ýǒƮǍƙ ǑNjǍ :ýǒƮǍƙ!ƒ lƧƓnjdž -

ƩƓǒl!ƒ lƨnjƞD ýǒƮǍƙǍ ƗǒǉǍƧƙǂ!Ǖƒ yƱl!ƒ LJǒƜ ýǒƮǍƙ!ƒǍ ƗǒǉǍƧƙǂ!Ǖƒ lƧƑƒþ!ƒ ƧƮƓǉƵ ƗƼƓǂ

.ƗƜƪƓǉdž!ƒ

ƓnjǉƓǂdžǍ ýƓƱƵǕƒ ƔƓƜƪD/ƔƜƪ ƗƼƧƶdž! ýǍƮǍ!ƒ ǏǁƵ lƧþl!ƒ ǑNjǍ :ýƓƱƵǕƒ þǒþơƙ lƧƓnjdž -

.ƗơǒơƮ!ƒ ƾƧƱ!ƓƜ Ɠnjƙƞ!ƓƶdžǍ ƓnjƮǒƤƬƙǍ

LJdž lƧƑƒþ!ƒ Ǒ5 lþƶdž!ƒ lƨnjƞǕƒ ƸǁƙƤdž Džƒþƙƪƒ ǏǁƵ lƧþl!ƒ ǑNjǍ :lƨnjƞǕƒ Džƒþƙƪƒ lƧƓnjdž -

lƧǍƮ!ƓƜ Ɠnjƶdž ýdžƓƶƙ!ƒ ƗǒƼǒǂǍ lƧƓƬǓƒ DžƪƒƧǍ lƧƓƬǓƒ ýƤþdžǍ ƩƓǒl!ƒǍ ƒ ƒơƼ!ƒ lƨnjƞD

.ƗơǒơƮ!ƒ

ƇƒƧƞƪ ƥƶƙ ƚőƑƓǌǉ!ƒ ǋƑƓƙǉǉ! ýĂƮĂ!ƒ Ĭ ƵƵ Ɣ!ƓƱ!ƒ lƧƥp ŎǋĂ :ǋƑƓƙǉ!ƒ ƒ ŭƤƙƪƒ lƧƓǌdž -

.ƓǋƧőƪ5ƙĂ ƚőƧƲǉ!ƒ ǅől!Ɠƙ ƓǌƙǉƧƓldž ýƞƊ ǇdžƚƥƥƙƘƒƇƒƧl!ƒ ýőƞƪƙĂ ƚƙƧƞƙ!ƒ

Ŏùƪƥdž lƧùƙƤ Ǉùdž ƚùőldžƶ!ƒ ƘƒƧƓùǌdž!ƒ ƔƓƪƙƚŬ ƚƲơŭdž!ƒ ƩƓőldž ƘƒƧl5 ƘlƙƮƑ

) ǇőǋƓùƮ ýƛdž ýƞƒƧdž!ƒĂ ƘƓƪƒƧƥ!ƒ Ư ƶƙ Ĭ ƵƵ ƓƯőƊ ƪƥdžƙƶdžĂ ƚơƓƙ!ƒ lƧƙƤĂ ƚőldžƶ!ƒ ƘƒƧƙƙƤdž!ƒ

ƔƓƪùƙƚƪ ƩƓùől! ǁù!ƦĂ .(2008) ĭƥùdžƓƺ!ƒ Ü(1990) ƧĂƧƪ Ü(2005) ƔƓƱơĂ Ü(2004

ǁù!ƦĂ Ý ƒ ƓƮƙƤŬƒ ĭĂƦ Ǉdž ǋdžőƚơƙ ǅƙ ǇƊ ƥƶƙ ƚőǉĂƧƙƚ!Ɠƒ ƚƪƥǉǌ!ƒ ƚƙƱ ăƥ! ƚőldžƶ!ƒ ƘƒƧƓǌdž!ƒ

ÜƚùlőpƥĂ ƚldžƓƮ ǋƙƒƧƓƙƵ ǇƊ Ĭ!ƍ ƚ5ƓƯŰƓƙ ÜƠőơƮƙ!ƒĂ ƽőƙƱƙ!ƒĂ ǅődžƮƙ!ƒ Ŏ5 ƚ!ĂǌƪƓƙ ƨƓƙdžő ǋǉŪ

ǋƙƧĂƮùƙ ƩƓùőldž!ƒ ǇĂùƚƙ ƥpĂ Ü(Ǉƚdžƙdž ƧőƺÜǇƚdžƙdž) ƩƓőldž!ƒ ƒƦǌ! ŎƑƓǉƛ!ƒ ǋőƧƥƙ!ƒ ƥƓdžƙƵƒ ǅƙĂ

ƘƒƧƓùǌdž!ƒ ƓǌƵĂdžƞdž Ŏ5 Ʃőlƙ ƚőƵƧ5 lƧƓǌdž 26 Ĭ ƵƵ ƚƵƨĂdž ƚƪőƑƧ ƘƒƧƓǌdž ƩdžƤ Ǉdž ƚő!ĂŰƒ

.ƚƙƱ!ƒ ăƥ! ƚőldžƶ!ƒ

ƙĭƚǅǄyǁƐ lƐƥƑǋǅǄǁƐ ƒƑƨƚlƐ ƧƑĭƽǅ ƃƑdžƓ 5ƍƮ - ƒ

ǇődžƚơDž!ƒ Ǉdž ƚƵĂdžƞdž Ĭ ƵƵ ǋƯƧƵ ƽőƧƱ ǇƵ ƩƓőldž!ƒ ƽƥƮ Ǉdž ƽlơƙ!ƒ ǅƙ

Ɠdžƚ ÜƚőldžƶDž!ƒ ƚőƧƙƤdž!ƒ ƘƒƧƓǌdž!Ɠƙ ǇőƮ ƮƤƙdž!ƒĂ ÜǅĂƵ!ƒ ǋǋƓǉdž ýƓƞdž Ŏ5 ƇƒƧƙƤ!ƒĂ ǇőƮ ƮƤƙdž!ƒ

ƘƓdžőƵƙ ƟĂƯĂ ƇĂƯ Ŏ5 ƩƓőldž!ƒ ƇƓǉƙ lƥĂƞ Ĭ ƵƵ ǅƚơ!ƒ ǇődžƚơDž!ƒ Ǉdž ƔƵƱĂ (18) ƽơldž!ƒ Ŏ5

ƚőĂƺ!ƒ ƚƩƓőƮ!ƒ ƚƙƪƓǉdž ăƥdžĂ ÜƚőǉĂƧƙƚ!ƒýƒ ƚƪƥǉǌ!ƒ ƚƙƱ ăĂƙƪdž! ƘƒƧƓƙƶ!ƒ ƚƙƪƓǉdžĂ ÜƩƓőldž!ƒ

ǅƙ ǇődžƚơDž!ƒ ƇƒƧƈ ƇĂƯ ŎĂ5 .ƩƓőldž!ƒ ƳĂƯĂdžƙ ƘƒƧƓƙƶ!ƒ ƱƓƙƧƪ ăƥdžĂ ÜƩƓőldž!ƒ ƘƒƧƓƙƶ!

ƚpƓƱƙ ƘƧǌƲ ĬƙơÜƓǌǉdž ƘƒƧl5 ƻƦơ ĂƊ ƓǌƯƶƙ ƧőőƺƙĂƊ ƩƓőldž!ƒ ƘƒƧl5 ƯƶƙýőƥƶƙlƧƓǌdž (26) Ĭ!ƒ ƚƑƨƞdž ƚƪőƑƧ ƘƒƧƓǌdž (5) Ǉdž ƘǉĂƚƙ Ŏƙ!ƒĂ ƚőƑƓǌǉ!ƒ ƓǌƙƧĂƮ Ŏ5 ƚƲơŭdž!ƒ

Ǉdž ƽlơƙ!ƒ ƥƮlƙĂ .(20) ƽơldž!ƒĂ (19) ƽơldž!ƒ Ŏ5 Ɠdžƚ ƚőƨőƞǉŬƒĂ ƚőƙƧƶ!ƒ ǇőƙƺDž!Ɠƙ ÜƚőƵƧ5

Ɠǌ ƯƶƙƙƘƒƧƓǌdž!ƒ Ǉőƙ ƚdžŭƶ!Ɠƙ ƚƮƓƤ!ƒ ǇĂƪƧőƙ ƱƓƙƧƒ ƘŭdžƓƶdž ƔƓƪơ ǈƙ ƥl5 ÜŎƤƒƥ!ƒ ƽƥƮ!ƒ

ǰƦnj! ǑǁƤƒþ!ƒ ƾþƮ!ƒ LJǿƙ ǑƘ!ƒĂ ƱǤƙƧǙƒ ƘǛǆǤƶǆ ǅǿþ (11) ýĂþƞ!ƒ LJǿǃĂ .ǂǿǁǂ!ƒ ǂƞƧþ!ƒĂ

.lƒþǙƒ

ǂǿǁǂ!ƒ ǂƞƧþ!ƒĂ ǤǌưƶǃǄ ƘƒƧǤǌǆ!ƒ LJǿǃ ƱǤƙƧǙƒ ƘǛǆǤƶǆ .11ýĂþƞ

ǂǃƱǤƙƧǙƒ ǂƥǛƶ!ƒ	ƧǤǿƘƤƒ lƧǤǌǆ lƨnjƞǙƒĂ ýƱl!ƒ ǂǃƖǤǈǆ!ƒ	lƧǤǌǆ þǿþơƘ ýǤƱƵǕƒ	lƧǤǌǆ ýǿƮĂƘ!ƒ	lƧǤǌǆ þǿþơƘ ýǤƱƵǕƒ	lƧǤǌǆ ƒ ǚƤƘƖƒ ǋƑǤƘǉ!ƒ
ýƱl!ƒ ƧǤǿƘƤƒ lƧǤǌǆ ǂǃƖǤǈǆ!ƒ lƨnjƞǙƒĂ	1				
ýǿƮĂƘ!ƒ lƧǤǌǆ	.422**	1			
ýǤƱƵǕƒ þǿþơƘ lƧǤǌǆ	.466**	.314**	1		
lƨnjƞǙƒ ǅƒþƤƘƖƒ lƧǤǌǆ	..221*	.406**	.406**	1	
ǋƑǤƘǉ!ƒ ƒ ǚƤƘƖƒ lƧǤǌǆ	.498**	.706**	.635**	.767**	1

* ǂ!ƒþ ƠƑǤƮơǫ ǂ!ƒþ ǄƖƗ ăĂƘƖǅ ǂ!ǙƐ!ƒ (0.05).

** ǂ!ƒþ ƠƑǤƮơǫ ǂ!ƒþ ǄƖƗ ăĂƘƖǅ ǂ!ǙƐ!ƒ (0.01).

ǂ - ǃƑǤƘ ƧƑǐƸǅ ƒƑƨǂ!ǁ ǃǁþƑǋǅǁ (ƘƑǤƘ ǃƑǤƘ) (ǃǅƑƯǤǁ

ǂǿǅǆƶ!ƒ ƔƧǤƞƘ!ǤǄ ǅnjǅǤǿþ ǤǤǰƒ ǂǃǁƱ!ƒ LJǅ (10) ǂƲơǚǆ ǅƙ ǂƲơǚǆ!ƒ ǂþǤƱǃ ƘǤǃƛ ƔǤƖơ!

ýǅǤƶǅ ƔǤƖơ ǅƙ þþĂ Ǖǰþơ ǏǁƗ ýǂ ǂǃǁƱ!ƒ ƘǤƲơǚǅǃ ƧƤƒ ýǿǅƨĂ ǂơǃǃ!ƒ ǅǤǿþ ýǚƤ LJǅ ǁ!ƦĂ

:ǂǿǙƒ Cooper ƧǃĂǂ ǂ!þǤƶǅ ǅƒþƤƘƖǃ ƘǤǃƛ!ƒ

:ƘǤǃƛ!ƒ ýǅǤƶǅ ƔǤƖơ! (Cooper formula) ƧǃĂǂ ǂ!þǤƶǅ

$$\text{معامل الثبات} = \frac{\text{عددمرات الاتفاق بين المدرسين}}{\text{عددمرات الاتفاق} + \text{عددمرات الاختلاف}} \times 100\%$$

(237 Ü2007Üǂǰǂǰƨǂ LJǅơƧ!ƒ þǃƵ)

$$\text{معامل الثبات} = \frac{223}{37 + 223} \times 100\%$$

ǂǿǰǤǂǅǫĂ ǂþǤƱǃ!ƒ ƘǤǃƛ! ǂǅƑǚǅ ǂǃƖǰ ǑǋǰĂ Ü(%85.8) ƾǤǙǙƒ ǂǃƖǰ ƱƖĂƘǅ ƸǁǃƘ þþĂ

ƘƒƧǤǌǆ!ƒ ƔǤƖǂǂ Ǒ5 LJǿǰǤƙ LJǿƖƧþǅ LJǿǃ ƾǤǙǙƒ (12)ýĂþƞ!ƒ ƠưĂǿĂ ÜǂƖƒƧþ!ƒ Ǒ5 ǤǌǅǿƲĂƘ

.ǂǿǅǆƶ!ƒ

[illegible] .12 [illegible]

[illegible]	[illegible]	[illegible]
12	48	[illegible]
7	43	[illegible]
5	35	[illegible]
4	36	[illegible]
9	61	[illegible]
37	223	[illegible]

[illegible] – [illegible]

[illegible]

[illegible] (50) [illegible].

[illegible] – [illegible]

(0=[illegible] [illegible] 1=[illegible]) [illegible]

[illegible]

[illegible].

[illegible] – [illegible]

[illegible]:

[illegible]: [illegible]: [illegible]

[illegible] (20) [illegible] (21).

ƘƒƧƠùnjdž ƔƠƪùƙǂƸ ƧƠǀƙƤƸǍ ÜƗŏƪƥǇnj!ƒ DžŏNjƠƽdž!ƒ ƔƠƪƙǂƸ ƧƠǀƙƤƸ ƇƠǇǀ Džƙ :ƗƪƒƧƥ!ƒ ƘƒǍƥD ƥƒƥƵǪ -2

ƠùnjŏƸ ƧƠƬùdž!ƒ ƘƒƇƒƧƞű! ƠǀƼǍ ÜƗŏǀdžƶ!ƒ ƘƒƧƠnjdž!ƒ ƔƠƪƙǂŬ ƗƲơŭdž!ƒ ƗpƠƱǀǍ ÜƥpƠǇ!ƒ ƧŏǂƽƙƸƒ

lƧǍƮù!Ơǀ ƠNjƥƒƥùƵǪǍ ƠùnjŏǀƵ ƗdžƨŭƸƒ ƘŭŏƥƶƙƸƒ ƇƒƧƞǪǍ ƠnjƙƠǀƛǍ ƠnjpƥƮ LJdž ƾǀơƙ!ƒǍ ÜƠǀǀƪdž

.ƗŏƑƠnjǇ!ƒ

Ƨǂŏdž ƘǂƧŏƪ!ƒ ƗŏƞdžƧǀ ǑNjǍ ǑưƒƧƙƼŬƒ ƧǀƙƤdž!ƒ Ǒƽ ƠnjdžƒƥƤƙƪŬ ƗǀƪƠǇdž!ƒ ƗŏƞdžƧǀ!ƒ ƧƠŏƙƤƸ -3

.ǁǍdžƧŏ!ƒ ƗƶdžƠƞ! ƗƮƤƧdžǍ lƥdžƙƶdž ƗŏƞdžƧǀ ǑNjǍ (Circuit Maker)

ƘƠŏǇǍƧƙǂ!Ŭƒ ƗƪƥǇNj DžƪpǍ ǁǍdžƧŏ!ƒ ƗƶdžƠƞǀ ǑdžǀƶƸ Ɨơǀ!ƒ lƥƠdžƵ LJdž ƗǀƼƒǍdž!ƒ ǏǀƵ ýǍƮơ!ƒ -4

.(1 ƾơǀdž) Ɨŏ!Ơơ!ƒ ƗƪƒƧƥ!ƒ ƇƒƧƞǪ LJdž LJǂdžƙǀ! ǁ!ƦǍ ƗŏƞǍ!ǍǇǂƙ!ƒ ƗƪƥǇnjǀ! ǐǍƠƞơ!ƒ Ɨŏǀǂ Ǒƽ

.ƗŏǇǍƧƙǂ!Űƒ ƗƪƥǇnj!ƒ ƘƒƧǀƙƤdž ƔƶƬ LJdž ƗŏƑƒǍƬƶ!ƒ ƗǀŏƧƱ!Ơǀ ƗƪƒƧƥ!ƒ ƗǇŏƵ ƧƠŏƙƤƸ -5

lƧƠƙƤdž!ƒ ƔƶƬ!ƒ Σ ŏƧƥƙ Ǒƽ LJŏǂƧƠƬdž!ƒ ƘƠƪƥǇnjdž!ƒǍ LJŏƪƥǇnjdž!ƒǍ LJŏƪƧƥdž!ƒ ƗǀƼƒǍdž ƦƤD -6

ƾŏǀƱƙǍ ƗƪƒƧƥ!ƒ ƘƠƞ!ƠƶdžƦ ƦŏƽǇƙǀ DžƠŏǀ!ƒ ýƞD LJdž lƥƥơdž!ƒ ƗŏƪŏƧƥƙ!ƒ lƧƙƽ!ƒ ǏǀƵ DžnjƶdžƾŏƪǇƙ!ƒǍ

.ƠnjƙƒǍƥD

Ɨùƪƒ ƧƥƇ ƘƠùƵǍdžƞdž ƧƠùŏƙƤƸ ǁ!ƦýŭƤ DžƙǍ ÜLJŏǂƧƠƬdž!ƒ LJŏƪƥǇnjdž!ƒ ýdž Ɨŏ!ǍD ƗǀǀƞƘƙǀƵ-7

Džùƙ ǁ!ƦùǂǍ ÜƗùƪƒƧƥ!ƒ ƘƠƵǍdžƞdž ǏǀƵ ƠŏƑƒǍƬƵ ƘƠƞ!ƠƶdžƒýŏƨǍƙ Džƙ ÜƗŏƑƒǍƬƶ!ƒ ƗǀŏƧƱ!Ơǀ

ƘŭdžƠùƶdžǍ ÜƘƠùǀǂ!ƒ ƔƠƪùơ! ƠnjŏǀƵ ƗƪƒƧƥ!ƒ ƘƒǍƥD ƾŏǀƱƙ ƨƥnjǀ ƗŏƵŭƱƙƪƒ ƗǇŏƵ ƧƠŏƙƤƸ

.ƨŏŏdžƙ!ƒǍ ƗǀǍƶƮ!ƒ

NJdžƠùǇƧǀ!ƒ ƦùŏƽǇƙ Ɨùŏƽŏǂ ǏǀƵ ƾƠƽƙŭ! ƗǀǀŏƧƞƙ!ƒ ƗƵǍdžƞdžǀ! LJŏƪƥdž!ƒ LJŏƪƥǇnjdž!ƒ ƇƠǇǀǀ ƇƥǀǇ!ƒ -8

ƯƒƧùƸŰ ǇƥƒƥùƵǪ Džùƙ ǐƦù!ƒ (ƗŏdžŏǀƶƙƸƒ ƗŏƞdžƧǀ!ƒ) ǑưƒƧƙƼŬƒ ƧǀƙƤdž!ƒ ƗǀŏƧƱǀ ǑƪŏƧƥƙ!ƒ

ƘƒƇƠùǀ! ýùǀƧD ýùpƒǍǀ Dž2013/6/6 ơŏƧƠƙ ǏƙơǍ Dž2013 /6 /2 ơŏƧƠƙǀ Ɨŏ!Ơơ!ƒ ƗƪƒƧƥ!ƒ

.2 ƮǇǍ LJŏƙƵƠƪ Ǐ!Ƹ 2 ƮǇǍ ƗƵƠƪ ƠnjǇdž ýǂ lƥdž ƗǀŏƧƥƙ

-9 [illegible]

[illegible]

-10 [illegible] 13 [illegible] 2013/2/3 [illegible] 2013/5/2 [illegible] (2:45) [illegible]

-11 [illegible] 8 [illegible] 2013/6/9 [illegible] 2013/8/1 [illegible] (2:45) [illegible] (21) [illegible]

-12 [illegible]

-13 ... (SPSS) ...

-14 ... (22) ...

- ...

- ...

- ... (3 – way ANCOVA) ...

- ǅƒþ Ŏƽ ƼĂƧƽ!ƒ Ʊƕư! (3 – way ANCOVA) (ƔơǴƮǆ!ƒ) ǑƛǖƛǃƒǇǑǴƙ!ƒ ýǒǇơƙ

ƧǴƙƤƒĂ ÜǑǇƕ!ƒ Ŧǒƪþǌ!ƒ ǅǒǋǴƽǆ!ƒ ƔǴƪƙǂƒ ƧǴƙƤƒ ǏǇƵ ǅƒþǕƒ ǇƵ ŦƞƙǴǉ!ƒ ŦƕǇƱ!ƒ

ŦǀǒƧƱ! ǴƶƕƙǑǇƕ!ƒ ŦǒǇǆƶ!ƒ ƘƒƧǴǌǆ!ƒ ƔǴƪƙǂƒ ŦƥǴƱƕĂ ÜǑǇƕ!ƒ þƥǴǉ!ƒ ƧǒǂƽƙǃƒƔǴƪƙǂƒ

.Ǵǆǌǉǒƕ ýƵǴƽƙ!ƒĂ Ʃǉƞ!ƒĂ ƒ ƮƤƙ!ƒĂ ƩǒƧþƙ!ƒ

- Effect Size ƧƛǕƒ ǅƞơ ŦƽƧƶǆ! (ŦǒǇǆƶ!ƒ Ŧ!Ǚþ!ƒ) Eta Square ǴƙǒƒyƕƧǆ ƜƒƧƤƙƪƒ

(ǈǴǂǴơǆ!ƒ ŦǒƞǆƧƕ) ǑưƒƧƙƽǕƒ ƧƕƙƤǆ!ƒ ŦǀǒƧƱƕ ŦǒǉĂƧƙǂ!Ǘƒ Ŧƪþǌ!ƒ ƩǒƧþƙ ƧƛǅƩǴǒ!

ŦƕǇƱ ăþ! ŦǒǇǆƶ!ƒ ƘƒƧǴǌǆ!ƒĂ ÜþƥǴǉ!ƒ ƧǒǂƽƙǃƒƘƒƧǴǌǆĂ ÜŦǒƪþǌ!ƒ ǅǒǋǴƽǆ!ƒ ƔǴƪƙǂƒ Ŏƽ

.ŦǒƕǒƧƞƙ!ƒ ŦƵĂǆƞǆ!ƒ

- ǅǒǋǴƽǆ!ƒ ƔǴƪƙǂƒ ƧǴƙƤƒ ǏǇƵ ŦƕǇƱ!ƒ ƘǴƞƧþ! Ŧ!ƥƶǆ!ƒ ŦǒƕǴƪơ!ƒ ƱǴƪĂǕƒ ǅƒþƤƙƪƒ

ƘƒƧǴǌǆ!ƒ ƔǴƪƙǂƒ Ă Üĭþƶƕ!ƒ þƥǴǉ!ƒ ƧǒǂƽƙǃƒƘƒƧǴǌǆ ƔǴƪƙǂƒ ƧǴƙƤƒĂ Üĭþƶƕ!ƒ Ŧǒƪþǌ!ƒ

ŦǀǒƧƱ ƘƒƧǒƺƙǆ! ǴƶƕƙăƨƶƙƘǴƵĂǆƞǆ!ƒ ĭǕ ŦǒƕǴƪơ!ƒ ƼĂƧƽ!ƒ ŦƽƧƶǆ! ŦǒǇǆƶ!ƒ

.ǴǆǌǉǒƕýƵǴƽƙ!ƒĂ Ʃǉƞ!ƒĂ ƒ ƮƤƙ!ƒĂ ƩǒƧþƙ!ƒ

الفصل الرابع

نتائج الدراسة

[illegible]

[illegible] (SPSS) [illegible]

[illegible]

[illegible] (Circuit Maker) [illegible]

[illegible] ($0.05 = \alpha$) [illegible]

[illegible]

[illegible]

[illegible] (13).

ᶅƐþĭƩŧĐŽ ƒƨΘ Ĭŧǅƨllɛ hŭĭƨơŀďžŊllɛ !ĭljƑƻĐŽllɛ þƑǅŧƣŀŰ hŭĭþƑĭÿĐŽllɛ ᶅƑƺƐþΘďžŪƐŊ hŭĭǅƒƨΘllɛ ᶅƑƯƨŊŧĐŽllɛ .**13** üŊŀơŀll
ţ ŢƣŧllƐŊ Ƨ ďžllƐŊ hŭšĭþƯllɛ

þþz!ƒ	ƻƒƧơŀŰƒ ĭƧĜŏzďž!ƒ	ƱʅĂƙďž!ƒ ŎĭIŀup /ŎŀoĜʅơ!ƒ	ƒ ŢƤƙ!ƒ	Ʃŀŋ!ƒ	ŧŀŏƧƱ!ƒ
15	2.808	11.80	ƘŬĆŢƙŬƒĂ ƘĜŏŀĄƧƙŧ!Ŭƒ	Ƨŧŗ	ŧŏŏƧŋƙ
11	4.382	15.00	ŧŏŀƱ!ƒĂ ƘĜŀʅĜơ!ƒĂ ăĂl!ƒ		
26	3.833	13.15	YĂďžŋďž!ƒ		
6	3.347	13.00	ƘŬĆŢƙŬƒĂ ƘĜŏŀĄƧƙŧ!Ŭƒ	Ĭλŀp	
12	4.609	13.83	ŧŏŀƱ!ƒĂ ƘĜŀʅĜơ!ƒĂ ăĂl!ƒ		
18	4.148	13.56	YĂďžŋďž!ƒ		
21	2.937	12.14	ƘŬĆŢƙŬƒĂ ƘĜŏŀĄƧƙŧ!Ŭƒ	YĂďžŋďž!ƒ	
23	4.439	14.39	ŧŏŀƱ!ƒĂ ƘĜŀʅĜơ!ƒĂ ăĂl!ƒ		
44	3.922	13.32	YĂďžŋďž!ƒ		
10	5.820	14.90	ƘŬĆŢƙŬƒĂ ƘĜŏŀĄƧƙŧ!Ŭƒ	Ƨŧŗ	ŧƱŀĆư
11	5.298	12.55	ŧŏŀƱ!ƒĂ ƘĜŀʅĜơ!ƒĂ ăĂl!ƒ		
21	5.544	13.67	YĂďžŋďž!ƒ		
11	4.009	13.45	ƘŬĆŢƙŬƒĂ ƘĜŏŀĄƧƙŧ!Ŭƒ	Ĭλŀp	
12	3.525	11.67	ŧŏŀƱ!ƒĂ ƘĜŀʅĜơ!ƒĂ ăĂl!ƒ		
23	3.788	12.52	YĂďžŋďž!ƒ		
21	4.881	14.14	ƘŬĆŢƙŬƒĂ ƘĜŏŀĄƧƙŧ!Ŭƒ	YĂďžŋďž!ƒ	
23	4.379	12.09	ŧŏŀƱ!ƒĂ ƘĜŀʅĜơ!ƒĂ ăĂl!ƒ		
44	4.687	13.07	YĂďžŋďž!ƒ		
25	4.439	13.04	ƘŬĆŢƙŬƒĂ ƘĜŏŀĄƧƙŧ!Ŭƒ	Ƨŧŗ	YĂďžŋďž!ƒ
22	4.908	13.77	ŧŏŀƱ!ƒĂ ƘĜŀʅĜơ!ƒĂ ăĂl!ƒ		
47	4.628	13.38	YĂďžŋďž!ƒ		
17	3.687	13.29	ƘŬĆŢƙŬƒĂ ƘĜŏŀĄƧƙŧ!Ŭƒ	Ĭλŀp	
24	4.162	12.75	ŧŏŀƱ!ƒĂ ƘĜŀʅĜơ!ƒĂ ăĂl!ƒ		
41	3.934	12.98	YĂďžŋďž!ƒ		
42	4.106	13.14	ƘŬĆŢƙŬƒĂ ƘĜŏŀĄƧƙŧ!Ŭƒ	YĂďžŋďž!ƒ	
46	4.513	13.24	ŧŏŀƱ!ƒĂ ƘĜŀʅĜơ!ƒĂ ăĂl!ƒ		
88	4.299	13.19	YĂďžŋďž!ƒ		

[illegible] (14) [illegible]

[illegible]

[illegible] .14 [illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
.778	.080	1.472	1	1.472	[illegible]
.546	.368	6.792	1	6.792	[illegible]
.977	.001	.015	1	.015	[illegible]
.534	.390	7.193	1	7.193	[illegible]
.033	4.691	86.503	1	86.503	[illegible]
.635	.227	4.193	1	4.193	[illegible]
.439	.604	11.135	1	11.135	[illegible]
		18.439	80	1475.088	[illegible]
			87	1607.716	[illegible]

[illegible]

[illegible] .(15)

ƕǐďŊƿŀŀǛƐ ƕƨơďŊŀƐ ƕĜŀƲ ƀƐƢǓ ƕŀơyĎŀƐ ƖƑƲƨŊŀĎŀƐŊ ƕǐƿƑǐyĎŀƐ ƖƑƺƐƿƟďǓƐŊ ƕǐĜƑƨƟŀƐ ƖƑƲƨŊŀĎŀƐ **.15** üŊơŀŀ

ƫ ƬƢŀƐ ƧďŀŀƐŊ ƕƺǐƿƲŀŀ ƒyĜŀ ƕǐƨơďŊŀƐ !ǐjƑƶĎŀƐ ƿƑĜŀƢƐ ĂŀY

ϸϸẓ!ƒ	ƱƖĂƙďž!ƒ ýϸẓďž!ƒ	ĭϸẓŀ!ƒ		Ŏŀŀŀ!ƒ		ƒ ƬƤƙ!ƒ	Ʃŀjƞ!ƒ	ƗŀŏƧƱ!ƒ	
		2ƒƧơŀjŰƒ ĭƧĜŏẓďž!ƒ	ƱƖĂƙďž!ƒ ŎŀĜƖơ!ƒ	2ƒƧơŀjŰƒ ĭƧĜŏẓďž!ƒ	ƱƖĂƙďž!ƒ ŎŀĜƖơ!ƒ				
15	31.29	2.924	30.47	2.808	11.80	ƘǗĜƬƙǗƒĂ ƘĜŏŀĂƧƙŀ!Ǘƒ	ƧŀƦ	ƗŏŀŏƧƞƙ	ƒƑƨŀƐ !ǐjƑƶĎŀƐ ƕǐƨơďŊŀƐ
11	22.93	5.514	24.00	4.382	15.00	ŀŏŀƱ!ƒĂ ƘĜŀƖĜơ!ƒĂ ăĂ!ƒ			
26	27.11	5.250	27.73	3.833	13.15	YĂďƞďž!ƒ			
6	30.61	3.937	30.50	3.347	13.00	ƘǗĜƬƙǗƒĂ ƘĜŏŀĂƧƙŀ!Ǘƒ	Ĭ ƛŀjϷ		
12	23.04	6.244	23.42	4.609	13.83	ŀŏŀƱ!ƒĂ ƘĜŀƖĜơ!ƒĂ ăĂ!ƒ			
18	26.83	6.449	25.78	4.148	13.56	YĂďƞďž!ƒ			
21	30.95	3.140	30.48	2.937	12.14	ƘǗĜƬƙǗƒĂ ƘĜŏŀĂƧƙŀ!Ǘƒ	YĂďƞďž!ƒ		
23	22.98	5.780	23.70	4.439	14.39	ŀŏŀƱ!ƒĂ ƘĜŀƖĜơ!ƒĂ ăĂ!ƒ			
44	26.97	5.780	26.93	3.922	13.32	YĂďƞďž!ƒ			
10	20.59	5.892	21.60	5.820	14.90	ƘǗĜƬƙǗƒĂ ƘĜŏŀĂƧƙŀ!Ǘƒ	ƧŀƦ	ŀƱŀĜƿ	
11	22.38	6.434	22.00	5.298	12.55	ŀŏŀƱ!ƒĂ ƘĜŀƖĜơ!ƒĂ ăĂ!ƒ			
21	21.49	6.030	21.81	5.544	13.67	YĂďƞďž!ƒ			
11	22.30	7.904	22.45	4.009	13.45	ƘǗĜƬƙǗƒĂ ƘĜŏŀĂƧƙŀ!Ǘƒ	Ĭ ƛŀjϷ		
12	21.07	6.379	20.17	3.525	11.67	ŀŏŀƱ!ƒĂ ƘĜŀƖĜơ!ƒĂ ăĂ!ƒ			
23	21.69	7.079	21.26	3.788	12.52	YĂďƞďž!ƒ			
21	21.44	6.859	22.05	4.881	14.14	ƘǗĜƬƙǗƒĂ ƘĜŏŀĂƧƙŀ!Ǘƒ	YĂďƞďž!ƒ		
23	21.73	6.328	21.04	4.379	12.09	ŀŏŀƱ!ƒĂ ƘĜŀƖĜơ!ƒĂ ăĂ!ƒ			
44	21.59	6.529	21.52	4.687	13.07	YĂďƞďž!ƒ			
25	25.94	6.137	26.92	4.439	13.04	ƘǗĜƬƙǗƒĂ ƘĜŏŀĂƧƙŀ!Ǘƒ	ƧŀƦ	YĂďƞďž	
22	22.66	5.936	23.00	4.908	13.77	ŀŏŀƱ!ƒĂ ƘĜŀƖĜơ!ƒĂ ăĂ!ƒ			
47	24.30	6.296	25.09	4.628	13.38	YĂďƞďž!ƒ			
17	26.46	7.720	25.29	3.687	13.29	ƘǗĜƬƙǗƒĂ ƘĜŏŀĂƧƙŀ!Ǘƒ	Ĭ ƛŀjϷ		
24	22.05	6.393	21.79	4.162	12.75	ŀŏŀƱ!ƒĂ ƘĜŀƖĜơ!ƒĂ ăĂ!ƒ			
41	24.26	7.099	23.24	3.934	12.98	YĂďƞďž!ƒ			
42	26.20	6.779	26.26	4.106	13.14	ƘǗĜƬƙǗƒĂ ƘĜŏŀĂƧƙŀ!Ǘƒ	YĂďƞďž!ƒ		
46	22.36	6.140	22.37	4.513	13.24	ŀŏŀƱ!ƒĂ ƘĜŀƖĜơ!ƒĂ ăĂ!ƒ			
88	24.28	6.707	24.23	4.299	13.19	YĂďƞďž!ƒ			

ŀŏƧĜŏẓďž!ƒ ƘĜƼƒƧơŀjŰƒĂ ŀŏŀĜƖơ!ƒ ƘĜƱƖĂƙďž!ƒ Ŏƺ ƗŏƧŊĜƱ ƗŀjŏĜŀƙ (15) ýĂϸƞ!ƒ ƛĴŏŀŏ

2 ǔƙƤĜŀ ŀŏƖϸŀjƞ!ƒ ďŏŊĜƼďž!ƒ ƧĜŀƙƤƫ Ĭŀƶ ŀŏŀjĂƧƙŀ!Ǘƒ ŀƖϸŀjƞ!ƒ ŀŀŀƱ ĈƒϸŪ ŀ!ϸẓďž!ƒ ƘĜƱƖĂƙďž!ƒĂ

ơ!ĜƬ! ýϸẓďž!ƒ ŎŀĜƖơ!ƒ ƱƖĂƙďž!ƒ Ʃŀŀŀ ŀ ŏơ Ü ƒ ƬƤƙ!ƒĂ Ʃŀjƞ!ƒĂ ŀŀŏƧƱ!ƒ ƛĴď ý ŀ ƘƒƧŏƺƙď ƘĜƑƼ

Ü27.11ƧĂŀƦ) Ʃŀjƞŀ!Ă Ü26.97 (ŎƲƒƧƙƼǗƒ ƧŀƙƤď!ƒ ŀŀŏƧƱ) ŀŏŀŏƧƞƙ!ƒ ŀƵĂďƞďž!ƒ

ăĂl!f) Ɣ ƒ ƮƤkǐ!Ă Ü(30.95 ƘŬƓƮkŬfĂ ƘƓǒǉĂƧkǂ!Ŭf) ƉǏ ƒ ƮƤkǐ!Ă Ü(26.83 ǂƓǉƉĂ

ǂƱǻƓư!f ǂƵĂǆƞǆ!f Ơ!ƓƮ! ýþƶǆ!f ǑǻƓƪơ!f ƱƪĂkǆ!f ƸǐǻǋǑơ Ǒ5 .(22.98 ǂǒǻƱ!fĂ ƘƓǻƪƓơ!fĂ

ƉǏ ƒ ƮƤkǐ!Ă Ü(21.69 ǂƓǉƉĂ Ü21.49.ƧĂǂƦ) ƩǉƞǏ!Ă 21.59 (ǂǒþƓǒkƵŬf ǂlǒƧƱ!f)

Ü(21.73 ǂǒǻƱ!fĂ ƘƓǻƪƓơ!fĂ ăĂl!f) Ɣ ƒ ƮƤkǐ!Ă Ü(21.44 ƘŬƓƮkŬfĂ ƘƓǒǉĂƧkǂ!Ŭf)

ǑƛǜƛlĄ!f ǈǒƓǻk!f ýǒǐơk ƊǐfþƤkƪƒ Ɗǐk ǂǒǻƓƪơ!f ƘƓƱƪĂkǆ!f ǈǒǻ ǂǒƒƓƮơŬf ƫĂƧ5!f ǂ!Ŭþ ǈƓǒǻ!Ă

:Ǒǐǻ Ɠǆ ǈǒǻk ǂǒơ .(16) ýĂþƞ ƔơƓƮǆ!f

ĂǂƔ ƒǈǆƳƓ üƔƒƧǂǂƐǋ ƫ ƮƠǂǂƐǋ ƧǆǐǐƐǋ ƧǐþƠǂǂƐ ǻƨǐþƯ þkŬ ƒƟƒƮƊǂǂƐ ĬkǘkǂǂƐ ƊǐƒƒǂǂƐ üǐǂƟǂ .16 üǋǐƠǂǂ

ǻǐ ƨ ƠǆǋǂǂƐ !ǐǉƒƧƊǂǂƐ þƒƓǂƠǂƐ

ƧƛŬf Ɗǆƞơ	ǂ!Ŭþ!f ǂǒƒƓƮơŬf	Ƨ ǂǆǒþ	ƱƪĂkǆ ƘƓƶǻƧǆ!f	ƘƓƞƧþ ǂǒƧơ!f	ƔĂǆƞǆ ƘƓƶǻƧǆ!f	ƧþƮǆ!f
.190	.000	18.514	518.121	1	518.121	(Ǒǐǻl!f) ƔơƓƮǆ!f
.213	.000	21.414	599.275	1	599.275	ǂlǒƧƱ!f
.000	.971	.001	.038	1	.038	Ʃǉƞ!f
.122	.001	10.929	305.843	1	305.843	ƒ ƮƤk!f
.001	.836	.043	1.208	1	1.208	Ʃǉƞ!f Ă ǂlǒƧƱ!f
.131	.001	11.903	333.113	1	333.113	ƒ ƮƤk!f Ă ǂlǒƧƱ!f
.003	.632	.231	6.462	1	6.462	ƒ ƮƤk!f Ă Ʃǉƞ!f
.008	.417	.666	18.642	1	18.642	ƒ ƮƤk!fĂƩǉƞ!fĂǂlǒƧƱ!f
			27.985	79	2210.823	ƌƱƤ!f
				87	3913.455	ƔĂǆƞǆ!f

- ƫĂƧ5!f ƘƓƓƞĂ Üǂlǒ ƧƱ!f ƧƛŬ ăƶƶƙ (0.05 = α) ǂǒƒƓƮơƣ ǂ!Ŭþ ƘƒƦ ƫĂƧ5 þĂƞĂ

Ü ƒ ƮƤk!f ƧƛŬ ăƶƶƙ ǂǒƒƓƮơƣ ǂ!Ŭþ ƘƒƦ ƫĂƧ5 þĂƞĂĂ .ǂǒǻǒƧƞk!f ǂƵĂǆƞǆ!f Ơ!ƓƮ!

ƘƒƦ ƫĂƧ5 þĂƞĂĂ Ü(ƘŬƓƮkŬfĂ ƘƓǒǉĂƧkǂ!Ŭf) ƉǏ ƒ ƮƤk!f Ơ!ƓƮ! ƫĂƧ5!f ƘƓƓƞĂ

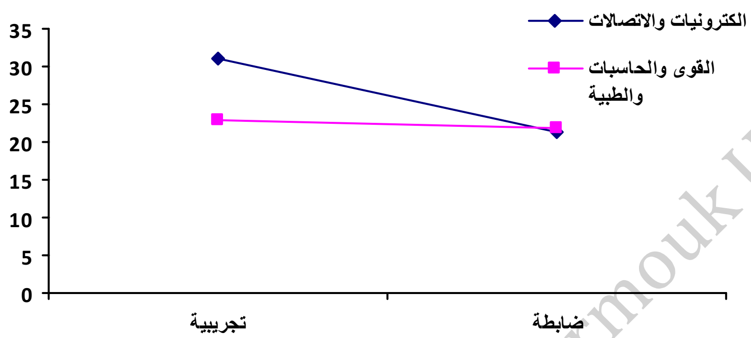
ǈǒǻ ƫĂƧ5!f ǈƓǒǻ!Ă . ƒ ƮƤk!fĂ ǂlǒƧƱ!f ǈǒǻ ǑƒƓǉĄ!f ýƵƓ5k!f ƧƛŬ ăƶƶƙ ǂǒƒƓƮơƣ ǂ!Ŭþ

.(12) ýǂƮ!f Ǒ5 Ɠǆǂ ƓǒǉƓǻ ƓǐǐǒƛǆǆǐƊǐk ǂ!þƶǆ!f ƘƓƱƪĂkǆ!f

[illegible] (0.05 = α) [illegible] -

[illegible]

[illegible] .



[illegible] :(**12**) [illegible]

[illegible] (12) [illegible]

[illegible] ([illegible]) [illegible]

:[illegible] Effect Size [illegible] .[illegible]

[illegible] (0,52) [illegible] $\sqrt{[\eta^2/(1-\eta^2)]}$ [illegible]

[illegible] (%52) [illegible]

[illegible] (%48) [illegible]

.([illegible])

[illegible] " :[illegible]

[illegible] (Circuit Maker) [illegible]

(**0.05** = α) [illegible]

[illegible]) [illegible]

[illegible] ([illegible]) [illegible] ([illegible]) [illegible]

ƥǴƞǒƒ ýƞǅ ǇǆǍ ƗǒƒǴƬơǙƒ ƘǴƞ!Ǵźǆ!ƒ ýǆƵ Ɨǒƒƥǁ!ƒ Ǒ5 ǅǁ Ǒǀǁ!ƒ ýƒƋƪ!ƒ ǇƵ ƗǁǴƞǘ!Ă

Ǒ5 ƘǴƵĂǆƞǆ!ƒ ƋƼǴǂǁ ǇǆǍ ƽǀơǁǀ!Ă .Ǒǁǀ!ƒ ƥƿǴǀ!ƒ Ƨǒǂƽǁ!ƒ ƘƒƧǴǌǆǍ ƧǴǁǁƤƒ Ǒ5 ƘǴƵĂǆƞǆ!ƒ ƋƼǴǂǁ

ƗǒƧǴǒźǆ!ƒ ƘǴƼƒƧơǀǙƒĂ ƗǒǁǴƪơ!ƒ ƘǴƱƪĂƘǆ!ƒ ƜƒƧƤǁƪƒ ǅǁ Ǒǁǀ!ƒ ƥƿǴǀ!ƒ Ƨǒǂƽǁ!ƒ ƘƒƧǴǌǆǍ ƧǴǁǁƤƒ

.(17) ýĂƥƞ!ƒ Ǒ5 ǴǆǂǍ ƒ ƬƤƘ!ƒĂ Ʃǀņ!ƒĂ ƗǀǒƧƱ!ƒ ƘƒƧǒƺǁǆ ƔƪơǍ

ǀƐƥǏƸƗǍ ƒƨƟ ǏǂǴƨǁǁ ǫƼƒǆǁ ƥǏǀƵǂǁ ǀƐƥǋǍ ƥƒǴƗƠǙ ǁǏƥƒǏýǍǁ ǀƒƺƐƥƟǆǕƐǈ ǁǏǴƒƨƟǁ ǀƑƯƨǋƗǍǁ **.17**ǖǋǙǁ

ƫ ƬƠƗǁƐǈ ƧǆǁǁƐǈ ǁƨǏƥƯǁ

ƥƥź!ƒ	ǏƧǴǒźǆ!ƒ ƺƒƧơǀǙƒ	Ǒǁǁƞ/ǑǁǴƪơ!ƒ ƱƪĂƘǆ!ƒ	ƒ ƬƤƘ!ƒ	Ʃǀņ!ƒ	ƗǀǒƧƱ!ƒ
15	2.597	6.80	ƘǙǴƬƘǙƒĂ ƘǴǒǀĂƧƘǂ!Ǚƒ	Ƨǂƻ	ƗǒǁǒƧƞǁ
11	2.562	6.82	ƗǒǁƱ!ƒĂ ƘǴǁƪǴơ!ƒĂ ăĂǀ!ƒ		
26	2.530	6.81	ƳĂǆǅƞǆ!ƒ		
6	2.503	6.33	ƘǙǴƬƘǙƒĂ ƘǴǒǀĂƧƘǂ!Ǚƒ	Ǐƛǈ	
12	2.774	6.67	ƗǒǁƱ!ƒĂ ƘǴǁƪǴơ!ƒĂ ăĂǀ!ƒ		
18	2.617	6.56	ƳĂǆǅƞǆ!ƒ		
21	2.517	6.67	ƘǙǴƬƘǙƒĂ ƘǴǒǀĂƧƘǂ!Ǚƒ	ƳĂǆǅƞǆ!ƒ	
23	2.615	6.74	ƗǒǁƱ!ƒĂ ƘǴǁƪǴơ!ƒĂ ăĂǀ!ƒ		
44	2.539	6.70	ƳĂǆǅƞǆ!ƒ		
10	2.983	7.30	ƘǙǴƬƘǙƒĂ ƘǴǒǀĂƧƘǂ!Ǚƒ	Ƨǂƻ	ƗƱǁǴư
11	2.601	6.18	ƗǒǁƱ!ƒĂ ƘǴǁƪǴơ!ƒĂ ăĂǀ!ƒ		
21	2.777	6.71	ƳĂǆǅƞǆ!ƒ		
11	2.508	6.91	ƘǙǴƬƘǙƒĂ ƘǴǒǀĂƧƘǂ!Ǚƒ	Ǐƛǈ	
12	2.256	6.00	ƗǒǁƱ!ƒĂ ƘǴǁƪǴơ!ƒĂ ăĂǀ!ƒ		
23	2.371	6.43	ƳĂǆǅƞǆ!ƒ		
21	2.682	7.10	ƘǙǴƬƘǙƒĂ ƘǴǒǀĂƧƘǂ!Ǚƒ	ƳĂǆǅƞǆ!ƒ	
23	2.372	6.09	ƗǒǁƱ!ƒĂ ƘǴǁƪǴơ!ƒĂ ăĂǀ!ƒ		
44	2.546	6.57	ƳĂǆǅƞǆ!ƒ		
25	2.708	7.00	ƘǙǴƬƘǙƒĂ ƘǴǒǀĂƧƘǂ!Ǚƒ	Ƨǂƻ	ƳĂǆǅƞǆ!ƒ
22	2.540	6.50	ƗǒǁƱ!ƒĂ ƘǴǁƪǴơ!ƒĂ ăĂǀ!ƒ		
47	2.614	6.77	ƳĂǆǅƞǆ!ƒ		
17	2.443	6.71	ƘǙǴƬƘǙƒĂ ƘǴǒǀĂƧƘǂ!Ǚƒ	Ǐƛǈ	
24	2.496	6.33	ƗǒǁƱ!ƒĂ ƘǴǁƪǴơ!ƒĂ ăĂǀ!ƒ		
41	2.451	6.49	ƳĂǆǅƞǆ!ƒ		

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
42	2.578	6.88	[illegible]	[illegible]	
46	2.491	6.41	[illegible]		
88	2.529	6.64	[illegible]		

[illegible] (18) [illegible]

[illegible]

[illegible] .18 [illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
.921	.010	.067	1	.067	[illegible]
.604	.271	1.835	1	1.835	[illegible]
.466	.536	3.634	1	3.634	[illegible]
.984	.000	.003	1	.003	[illegible]
.302	1.080	7.323	1	7.323	[illegible]
.819	.052	.356	1	.356	[illegible]
.963	.002	.015	1	.015	[illegible]
		6.784	80	542.682	[illegible]
			87	556.364	[illegible]

[illegible]

[illegible]

[illegible] (19) [illegible]

[illegible] .19 [illegible]

[illegible]

[illegible]	[illegible]	[illegible] (post)		[illegible] (pre)		[illegible]	[illegible]	[illegible]	
		[illegible]	[illegible]	[illegible]	[illegible]				
15	13.72	2.219	13.73	2.597	6.80	[illegible]	[illegible]	[illegible]	[illegible]
11	12.62	1.859	12.64	2.562	6.82	[illegible]			
26	13.17	2.108	13.27	2.530	6.81	[illegible]			
6	12.70	2.875	12.67	2.503	6.33	[illegible]	[illegible]		
12	12.75	2.417	12.75	2.774	6.67	[illegible]			
18	12.72	2.492	12.72	2.617	6.56	[illegible]			
21	13.21	2.399	13.43	2.517	6.67	[illegible]	[illegible]		
23	12.68	2.120	12.70	2.615	6.74	[illegible]			
44	12.95	2.261	13.05	2.539	6.70	[illegible]			
10	11.13	2.098	11.20	2.983	7.30	[illegible]	[illegible]	[illegible]	
11	11.23	2.442	11.18	2.601	6.18	[illegible]			
21	11.18	2.228	11.19	2.777	6.71	[illegible]			
11	10.24	1.794	10.27	2.508	6.91	[illegible]	[illegible]		
12	10.66	1.881	10.58	2.256	6.00	[illegible]			
23	10.45	1.805	10.43	2.371	6.43	[illegible]			
21	10.68	1.953	10.71	2.682	7.10	[illegible]	[illegible]		
23	10.94	2.138	10.87	2.372	6.09	[illegible]			
44	10.81	2.030	10.80	2.546	6.57	[illegible]			
25	12.42	2.475	12.72	2.708	7.00	[illegible]	[illegible]	[illegible]	
22	11.93	2.245	11.91	2.540	6.50	[illegible]			
47	12.17	2.380	12.34	2.614	6.77	[illegible]			
17	11.47	2.446	11.12	2.443	6.71	[illegible]	[illegible]		
24	11.70	2.390	11.67	2.496	6.33	[illegible]			
41	11.59	2.398	11.44	2.451	6.49	[illegible]			
42	11.95	2.560	12.07	2.578	6.88	[illegible]	[illegible]		
46	11.81	2.299	11.78	2.491	6.41	[illegible]			
88	11.88	2.417	11.92	2.529	6.64	[illegible]			

[illegible] (19) [illegible] [illegible] [illegible] [illegible] 13.17 [illegible] 12.95 [illegible]

ƘǴŮƓǴơ!ƒĂ ăĂI!ƒ) ƔǴ ƒ ƮƤƙǰ!Ă Ü(13.21 ƘŬǴƮƙŬƒĂ ƘǴǒǉĂƧƙǂ!Ŭƒ) ƊǴ ƒ ƮƤƙǰ!Ă Ü(12.72

ǂIǒƧƱ!ƒ) ǂƱƕǴƯ!ƒ ǂƵĂǆƞǆ!ƒ ƠǃǴƮ! ýƥƶǆ!ƒ ǑƕǴƓơ!ƒ ƱƓĂƙǆ!ƒ ƸǐƱ ǋǒơ Ǒ5Ă .(12.68 ǂǒƕƱ!ƒĂ

ƘǴǒǉĂƧƙǂ!Ŭƒ) ƊǴ ƒ ƮƤƙǰ!Ă Ü(10.45 ǂǴǉƥĂ Ü11.18.ƧĂǂƦ) ƩǉƞǴ!Ă Ü10.81(ǂǒƥǴǒƙƵŬƒ

ƪĂƨ5!ƒ ǂ!Ŭƥ ǋǴǒƕ!Ă Ü(10.94 ǂǒƕƱ!ƒĂ ƘǴŮƓǴơ!ƒĂ ăĂI!ƒ) ƔǴ ƒ ƮƤƙǰ!Ă Ü(10.68 ƘŬǴƮƙŬƒĂ

.(20) ýĂƥƞ ƔơǴƮǆ!ƒ ǑƛǗƛ!ƒ ǋǒǴƕƙ!ƒ ýǒǰơƙ ǅƒƥƤƙƓƒ ǅƙ ǂǒƕǴƓơ!ƒ ƘǴƱƓĂƙǆ!ƒ ǋǒƕ ǂǒƑǴƮơŬƒ

:ǑǐƕǴǆ ǋǒƕƙ ǂƕơ

ǗǎǁǊƾ .20 ǁƴƑǂ ǃǄǎǁƑǀ ǇǕǍǁƯ ǀǙǀ ǃǏƮǄǁ ǄǕǍǁ ƦǁƏǏǁǁǌ ƦǁƑǁǁǌ ƚ ƮǏǁǁǌ ǗƳƦǂǁǌ ǗƳƑǎǁ ǗǂƔ

ǃƽǁǏƯƦ ǁǋǑǉǏǁ ǀǃǁǂǁ ǀǏƯƦ

ƧƛŬƒ ǅƞơ	ǂ!Ŭƥ!ƒ ǂǒƑƮơŬƒ	ƻ ǂǆǒƥ	ƱƓĂƙǆ ƘǴƶƕƧǆ!ƒ	ƘǴƞƧƥ ǂǒƧơ!ƒ	ƳĂǆƞǆ ƘǴƶƕƧǆ!ƒ	ƧƥƮǆ!ƒ
.018	.228	1.476	6.958	1	6.958	(ǑǐǉI!ƒ) ƔơǴƮǆ!ƒ
.202	.000	19.937	93.990	1	93.990	ǂIǒƧƱ!ƒ
.019	.224	1.503	7.086	1	7.086	ƩǉƞI!ƒ
.001	.782	.077	.363	1	.363	ƒ ƮƤƙ!ƒ
.001	.763	.092	.432	1	.432	ƩǉƞI!ƒ Ă ǂIǒƧƱ!ƒ
.008	.415	.672	3.169	1	3.169	ƒ ƮƤƙ!ƒ Ă ǂIǒƧƱ!ƒ
.007	.450	.577	2.718	1	2.718	ƒ ƮƤƙ!ƒ Ă ƩǉƞI!ƒ
.002	.661	.193	.912	1	.912	ƮƤƙ!ƒĂƩǉƞI!ƒĂǂIǒƧƱ!ƒ ƒ
			4.714	79	372.439	ǂƱƤ!ƒ
				87	508.443	ƳĂǆƞǆ!ƒ

ƠǃǴƮ! ƪĂƨ5!ƒ ƘǴǉƞĂ ÜǂƵĂǆƞǆ!ƒ ƧƛŬ ăƨƶƙ (0.05 = α) ǂǒƑƮơƙ ǂ!Ŭƥ Ƙƒƥ ƪĂƨ5 ƥĂƞĂ -

ƧƛŬĂ ƩǉƞI!ƒ ƧƛŬ ăƨƶƙ ǂǒƑƮơƙ ǂ!Ŭƥ Ƙƒƥ ƪĂƨ5 ƥĂƞĂ ǅƥƵĂ .ǂǒƕǒƧƞƙ!ƒ ǂƵĂǆƞǆ!ƒ

ƩǉƞI!ƒĂ Ü ƒ ƮƤƙ!ƒĂ ǂIǒƧƱ!ƒĂ ÜƩǉƞI!ƒĂ ǂIǒƧƱ!ƒ ǋǒƕ ǑƑǴǉƛ!ƒ ýƵǴ5ƙ!ƒ ƧƛŬĂ Ü ƒ ƮƤƙ!ƒ

. ƒ ƮƤƙ!ƒĂ ƩǉƞI!ƒĂ ǂIǒƧƱ!ƒ ǋǒƕ ǑƛǗƛ!ƒ ýƵǴ5ƙ!ƒ ƧƛŬĂ Ü ƒ ƮƤƙ!ƒĂ

:ŀþŭž!ƒ ĎžƒþƤķʅƓǁ Effect Size ƧλŰƒ Ďžŋơ þƓŋŏǫ Ďķ ÜŀłŏƧƱ!ƒ ŀŏǁŽƓ5 þƓŋŏŰĂ

ĬǁŽ ŀŏǉǁďž!ƒ ΣŏƧþķ!ƒ ŀłŏƧƱ ǇĐ ŎǉžŏƒƦNjĂ Ý(0,50) ĭĂƓʅŏ ǋǉĐ þŋĂ þł5 Ü$\sqrt{[\eta^2/(1-\eta^2)]}$

ƘƒƧƓnjďž ƔƓʅķŧƒ Ŏ5 ǇŏƓǁķ!ƒ ǇĎž (%50) Ŏ!ƒĂơ Ƨʅ5ķ Ŏư ƒƧķ5Ůƒ ƧǁķƤďž!ƒ ŀłŏƧƱ ĎžƒþƤķʅƒ

ŀǁŏƧƹ ýďžƒĂŽ Ĭ!ǫ ăƨžŏĂ Ƨʅ5ďž Ƨŏƹ (%50) ǇŏƓǁķ!ƒ Ŏ5 ŎþƓǁ!ƒ ƓďžǉŏǁÜŀǁǁƱ!ƒ ăþ! þþƓǉ!ƒ Ƨŏŧ5ķ!ƒ

.(ŀŏŋƧƓƤ ƘƒƧλƋďž)

þłĭĎž lłþĭƨǁǁ ǁĭĎžĭŧyŧǁǁ ǁĭǁǁĎžþƓǁǁ !ǁǫƆŀƨǁƓ ĬƮǁþŀƺŰǁ þƓŀƆǁĎžǁǁ þķƈ ƑĎž " :ƘǁƑķǁǁ üǁDƨǁǁ

ǁyĎžƑǁǁ Ĭƺ ǁĭďžNjþŀłǁŪǁ ǁƨǫǁďžǉǁǁ ǁƓŧƲ njǫǁ ǁĭŧĎžyǁǁ lǁþƑǉĎžǁǁ ƒƑƨŀłǁ Ĭƺ (Circuit Maker)

Ĭƺ (**0.05** = **α**) ǁǁŰǫǁǁ njNjŀƨĎž ǫďžY ǁĭǝƑƬƟǝ ǁǁŰǫ lǁƤ 5Njþƺ ƿƑďžlj ǫǁǁNjĭ üljNj ÝƿNjĎžþĭǁǁ

ÛĬƮǁþŀƺŰǁ þƓŀƆǁĎžǁǁ) ƨĭþǫŀǁǁ ǁƽĭþƲ þķŬ njƦyŀ ǁƓŧƲǁǁ ƀŰĎlj njǫǁ ǁĭŧĎžyǁǁ lǁþƑǉĎžǁǁ ƒƑƨŀłǁ

ÝƑǉďžĭƓ üYƑƺŀǁǁNj (ƒÛƈ) ƫ ƬƆŀǁǁNj (ƘƑďžǁNj ÛþNjłƤ) ƨďžǁǁǁNj Û(ǁĭǫƑĭŀYŰǁNj

ǁǁƒƧƤķʅƒ Ďķ Ŏǁǁł!ƒ ŀŏǁďžž!ƒ ƘƒƧƓnjďž!ƒ ƧƓǁķƤƒ Ŏ5 ƘƓŽĂďžŋďž!ƒ ƋƼƓŧķ ǇĎž ƽłơķǁ!

Ɠďžŧ ƒ ƮƤķ!ƒĂ ΣǉŋǃƒĂ ŀŽĂďžŋďž!ƒ ƘƒƧŏƺķďž Ɣʅơ ŀŏƧƓŏžďž!ƒ ƘƓ5ƒƧơǉŬƒĂ ŀŏǁƓʅơ!ƒ ƘƓƱʅĂķďž!ƒ

.(21) ýĂþŋ!ƒ Ŏ5

lǁþĭƹŀĎž ƒƨƟ Ĭŧƈƽǁǁ ǁĭŧĎžyǁǁ lǁþƑǉĎžǁǁ þƑŀƆǁŰ ǁĭþƑĭyĎžǁǁ lƑƺǁþƟďžŪǁNj ǁĭƓƑƨƟǁǁ lƑƲƨNjŀĎžǁǁ .**21** üNjǫǁǁ

ƫ ƬƆŀǁǁNj ƨďžǁǁǁNj ǁYNjĎžǁǁĎžǁǁ

þþž!ƒ	ĭƧƓŏžďž!ƒ ƺƒƧơǉŰƒ	ŎǁƓʅơ!ƒ ƱʅĂķďž!ƒ	ƒ ƮƤķ!ƒ	Σǉŋ!ƒ	ŀŽĂďžŋďž!ƒ
15	7.206	5.73	ƘŬƓƮķŬƒĂ ƘƓŏǉĂƧķŧ!Ŭƒ	Ƨŧƚ	ŀŏǁŏƧŋķ
11	6.935	4.09	ŀŏǁƱ!ƒĂ ƘƓǁʅƓơ!ƒĂ ăĂ!ƒ		
26	7.000	5.04	YĂďžŋďž!ƒ		
6	4.457	4.33	ƘŬƓƮķŬƒĂ ƘƓŏǉĂƧķŧ!Ŭƒ	Ĭλǉ	
12	9.824	10.17	ŀŏǁƱ!ƒĂ ƘƓǁʅƓơ!ƒĂ ăĂ!ƒ		
18	8.735	8.22	YĂďžŋďž!ƒ		
21	6.460	5.33	ƘŬƓƮķŬƒĂ ƘƓŏǉĂƧķŧ!Ŭƒ	YĂďžŋďž!ƒ	
23	8.930	7.26	ŀŏǁƱ!ƒĂ ƘƓǁʅƓơ!ƒĂ ăĂ!ƒ		
44	7.820	6.34	YĂďžŋďž!ƒ		

10	8.249	7.60	ƘŬƓƮƙŬƒĂ ƘƓŏŀĂƧƙǂ!Ŭƒ	ƧǂƦ	ǂƱƕƓư
11	6.991	5.45	ǂŏƕƱ!ƒĂ ƘƓŵƪƓơ!ƒĂ ăĂ!ƒ		
21	7.501	6.48	YĂďƞď!ƒ		
11	7.778	5.09	ƘŬƓƮƙŬƒĂ ƘƓŏŀĂƧƙǂ!Ŭƒ	Ĭƛŀp	
12	6.994	5.00	ǂŏƕƱ!ƒĂ ƘƓŵƪƓơ!ƒĂ ăĂ!ƒ		
23	7.208	5.04	YĂďƞď!ƒ		
21	7.907	6.29	ƘŬƓƮƙŬƒĂ ƘƓŏŀĂƧƙǂ!Ŭƒ	YĂďƞď!ƒ	
23	6.835	5.22	ǂŏƕƱ!ƒĂ ƘƓŵƪƓơ!ƒĂ ăĂ!ƒ		
44	7.299	5.73	YĂďƞď!ƒ		
25	7.528	6.48	ƘŬƓƮƙŬƒĂ ƘƓŏŀĂƧƙǂ!Ŭƒ	ƧǂƦ	YĂďƞď!ƒ
22	6.831	4.77	ǂŏƕƱ!ƒĂ ƘƓŵƪƓơ!ƒĂ ăĂ!ƒ		
47	7.184	5.68	YĂďƞď!ƒ		
17	6.645	4.82	ƘŬƓƮƙŬƒĂ ƘƓŏŀĂƧƙǂ!Ŭƒ	Ĭƛŀp	
24	8.747	7.58	ǂŏƕƱ!ƒĂ ƘƓŵƪƓơ!ƒĂ ăĂ!ƒ		
41	7.972	6.44	YĂďƞď!ƒ		
42	7.147	5.81	ƘŬƓƮƙŬƒĂ ƘƓŏŀĂƧƙǂ!Ŭƒ	YĂďƞď!ƒ	
46	7.931	6.24	ǂŏƕƱ!ƒĂ ƘƓŵƪƓơ!ƒĂ ăĂ!ƒ		
88	7.527	6.03	YĂďƞď!ƒ		

ǇĴŏƓƙ!ƒ ýŏľơƙ ĎƒþƤƙƪƒ Ďƙ ǂŏƕƓƪơ!ƒ ƘƓƱƪĂƙď!ƒ ǉƦǋ ǇĴŏƕ ǖŏƑƓƮơƍ ǂ!ƒþ!ƒ ƽĂƧƽ!ƒ ǇƓŏƕ!Ă

.(22) ýĂþƞ!ƒ Ŏ5 ƠưĂď ĂǋƓďǂ Ŏƛǚƛ!ƒ

þƑƓǂƢƗ ĂǂY !ǋďǐƓ üYƑƧǂƗǋ ţ ƮƢǂƗǋ Ƨ ďƜƗǋ hYǋĎƜƗ ƖƐþǏƸď þƙŬ ĬƙǘƙƗ ĎǏƑƓƗ üǏǂƟǂ .22 üǋƣƜ
ĬǂƓƨƗ hǏǂĎǇƗ ƖƐþƑǋĎƗ

ǂ!Ŭþ!ƒ ǂŏƑƓƮơŬƒ	2 ǂďǒp	ƱƪĂƙď ƘƓƶƧď!ƒ	ǂŏƧơ!ƒ ƘƓƞƧþ	YĂďƞď ƘƓƶƧď!ƒ	ǇĴŏƓƙ!ƒ Ƨþƭď
.860	.031	1.798	1	1.798	ǂŀŏƧƱ!ƒ
.798	.066	3.794	1	3.794	ƩǉƞƗ!ƒ
.770	.086	4.944	1	4.944	ƒ ƮƤƙ!ƒ
.256	1.310	75.525	1	75.525	ƩǉƞƗ!ƒ Ă ǂŀŏƧƱ!ƒ
.339	.927	53.460	1	53.460	ƒ ƮƤƙ!ƒ Ă ǂŀŏƧƱ!ƒ
.157	2.038	117.540	1	117.540	ƒ ƮƤƙ!ƒ Ă ƩǉƞƗ!ƒ
.419	.660	38.034	1	38.034	ƒ ƮƤƙ!ƒĂƩǉƞƗ!ƒĂ ǂŀŏƧƱ!ƒ
		57.661	80	4612.879	ďƱP!ƒ
			87	4928.898	YĂďƞď!ƒ

:ŎķŬƒ (22) ýǍþŋ!ƒ ǈŏhŏ

ÜΣǉùŋ!ƒ ƧùƛŰǍ ÜŁùǀŏƧƱ!ƒ ƧƛŰ ăƨƶķ (0.05 = α) ŁŏƑǴŢơƺ Ł!Ůþ ƘƒƦ ƾǍƧ5 þǍŋǍ ǄþƵ -

Ü ƒ Ţ ùƤķ!ƒǍ ŁùǀŏƧƱ!ƒǍ ÜΣǉŋ!ƒǍ ŁǀŏƧƱ!ƒ ǇǆdžǇ ýǂ ǇŏhŏŎƑǴǉƛ!ƒ ýƵǴǩķ!ƒ ƧƛŰǍ Ü ƒ Ţ Ƥķ!ƒ ƧƛŰǍ

. ƒ ŢƤķ!ƒǍ Σǉŋ!ƒǍ ŁǀŏƧƱ!ƒ ǇŏhŏŎƛŭƛ!ƒ ýƵǴǩķ!ƒ ƧƛŰǍ Ü ƒ ŢƤķ!ƒǍ Σǉŋ!ƒǍ

ǄƒþŰ Ł!þƶdž!ƒ ƘǴƱʅǍķdž!ƒǍ ŁŏƧǴŏƶdž!ƒ ƘǴ5ƒƧơǉŬƒǍ ŁŏhǴʅơ!ƒ ƘǴƱʅǍķdž!ƒ ɰƒƧƤķʅƪ Ǆķ Ǵdžǂ

Σǉŋ!ƒǍ Σ ŏƧþķ!ƒ ŁǀŏƧƱ! ǴƶhƙŁŏǀdžƶ!ƒ ƘƒƧǴnjdž!ƒ ƧǴhķƤƪ ĬǀƵ ŁŏǉǍƧķǂ!Ůƒ Łʅþǉnj!ƒ ŁhǀƱ

.(23) ýǍþŋ!ƒ Ŏ5 ƠưǍdž ǍNj Ǵdžǂ ƒ ŢƤķ!ƒǍ

ŀŏǆǄNjþŁǀǀŬɛ ŀƨơǆNJǀɛ ŀǴǂƯ ƃɛǫŬ ŀǀǀǫỵǅǀɛ ǀƑƯƨNjŀǅǀɛNj ŀŏþƑĩỵǅǀɛ ǀƑǯɛþƟǆŬɛNj ŀŏǴƑƨƟǀɛ ǀƑƯƨNjŀǅǀɛ **.23** üNjǫǀǁ

ţ ŢǫǀŀǀɛNj Ƨ ǆǀǁǀɛNj Ƨ ǐþǫŀǀɛ ŀǂƽǐþƯǀ ƒỵǴŀ ŀŏŀǅỵǀɛ ǀɛþƑNJǅǀɛ þƑǴŀǫɛ Ǎǂ Y

þþƶ!ƒ	Ʊʅ Ǎķdž!ƒ ýþƶdž!ƒ	ǐ þƶh!ƒ		Ŏǀh!ƒ		ƒ ŢƤķ!ƒ	Σǉŋ!ƒ	ŁŏƧƱ!ƒ	
		ƨƒƧơǉŬƒ ǐ ƧǴŏƶdž!ƒ	Ʊʅ Ǎķdž!ƒ ŎhǴʅơ!ƒ	ƨƒƧơǉŬƒ ǐ ƧǴŏƶdž!ƒ	Ʊʅ Ǎķdž!ƒ ŎhǴʅơ!ƒ				
15	5.268	1.320	5.20	1.907	1.73	ƘŬǴŢķŬƒǍ ƘǴŏǉǍƧķǂ!Ůƒ	ƨǂƦ	ŁŏhŏƧȠķ	ƧǴŏķƤƪ ỵƱǀ!ƒ ǀƨnjŋŮƒǍ Łhʅ Ǵǉdž!ƒ
11	5.898	.405	5.82	1.968	1.45	ŁŏhƱ!ƒǍ ƘǴhʅǴơ!ƒǍ ăǍǀ!ƒ			
26	5.583	1.067	5.46	1.899	1.62	YǍdžȠdž!ƒ			
6	5.597	.408	5.83	2.858	2.83	ƘŬǴŢķŬƒǍ ƘǴŏǉǍƧķǂ!Ůƒ	Ĭƛǉŀ		
12	5.365	.778	5.33	2.417	3.25	ŁŏhƱ!ƒǍ ƘǴhʅǴơ!ƒǍ ăǍǀ!ƒ			
18	5.481	.707	5.50	2.494	3.11	YǍdžȠdž!ƒ			
21	5.433	1.161	5.38	2.202	2.05	ƘŬǴŢķŬƒǍ ƘǴŏǉǍƧķǂ!Ůƒ	YǍdžȠdž!ƒ		
23	5.631	.662	5.57	2.350	2.39	ŁŏhƱ!ƒǍ ƘǴhʅǴơ!ƒǍ ăǍǀ!ƒ			
44	5.532	.927	5.48	2.261	2.23	YǍdžȠdž!ƒ			
10	4.676	1.874	4.80	2.300	2.80	ƘŬǴŢķŬƒǍ ƘǴŏǉǍƧķǂ!Ůƒ	ƨǂƦ	ƱhǴư	
11	3.955	1.973	4.09	2.659	2.55	ŁŏhƱ!ƒǍ ƘǴhʅǴơ!ƒǍ ăǍǀ!ƒ			
21	4.316	1.912	4.43	2.436	2.67	YǍdžȠdž!ƒ			
11	5.595	1.036	5.45	2.018	1.55	ƘŬǴŢķŬƒǍ ƘǴŏǉǍƧķǂ!Ůƒ	Ĭƛǉŀ		
12	4.694	1.775	4.67	2.109	1.92	ŁŏhƱ!ƒǍ ƘǴhʅǴơ!ƒǍ ăǍǀ!ƒ			
23	5.144	1.492	5.04	2.027	1.74	YǍdžȠdž!ƒ			
21	5.136	1.493	5.14	2.197	2.14	ƘŬǴŢķŬƒǍ ƘǴŏǉǍƧķǂ!Ůƒ	YǍdžȠdž!ƒ		
23	4.324	1.852	4.39	2.354	2.22	ŁŏhƱ!ƒǍ ƘǴhʅǴơ!ƒǍ ăǍǀ!ƒ			
44	4.730	1.713	4.75	2.254	2.18	YǍdžȠdž!ƒ			
25	4.972	1.541	5.04	2.095	2.16	ƘŬǴŢķŬƒǍ ƘǴŏǉǍƧķǂ!Ůƒ	ƨǂƦ	YǍdžȠdž	
22	4.926	1.647	4.95	2.350	2.00	ŁŏhƱ!ƒǍ ƘǴhʅǴơ!ƒǍ ăǍǀ!ƒ			
47	4.949	1.574	5.00	2.195	2.09	YǍdžȠdž!ƒ			
17	5.596	.870	5.59	2.345	2.00	ƘŬǴŢķŬƒǍ ƘǴŏǉǍƧķǂ!Ůƒ	Ĭƛǉŀ		
24	5.029	1.383	5.00	2.320	2.58	ŁŏhƱ!ƒǍ ƘǴhʅǴơ!ƒǍ ăǍǀ!ƒ			

ƀƀz!ƒ	ƱƪĂkdž!ƒ ýƀzdž!ƒ	ĭƀzh!ƒ		Őǚh!ƒ		ƒ ƮƤk!ƒ	Σǉŋ!ƒ	ƗlőƧƱ!ƒ	
		ƻƒƧơǉŰƒ ĭƧĞzdž!ƒ	ƱƪĂkdž!ƒ ŎhǴƪơ!ƒ	ƻƒƧơǉŰƒ ĭƧĞzdž!ƒ	ƱƪĂkdž!ƒ ŎhǴƪơ!ƒ				
41	5.313	1.220	5.24	2.320	2.34	YĂdžŋdž!ƒ			
42	5.284	1.326	5.26	2.173	2.10	ĸŰǴƮkŰƒĂ ĸǴǉĂƨƗ!Űƒ	YĂdžŋdž!ƒ		
46	4.978	1.498	4.98	2.327	2.30	ƗǒhƱ!ƒĂ ĸǴhƪǴơ!ƒĂ ăĂ!ƒ			
88	5.131	1.418	5.11	2.245	2.20	YĂdžŋdž!ƒ			
15	4.473	1.356	4.47	1.944	1.07	ĸŰǴƮkŰƒĂ ĸǴǉĂƨƗ!Űƒ	ƨƗƦ	ƗǒhőƧŋk	ýőƮĂk!ƒ
11	4.385	1.214	4.45	1.567	.64	ƗǒhƱ!ƒĂ ĸǴhƪǴơ!ƒĂ ăĂ!ƒ			
26	4.429	1.272	4.46	1.774	.88	YĂdžŋdž!ƒ			
6	4.311	1.265	4.00	.000	.00	ĸŰǴƮkŰƒĂ ĸǴǉĂƨƗ!Űƒ	Ĭλip		
12	3.994	1.279	4.00	2.429	1.92	ƗǒhƱ!ƒĂ ĸǴhƪǴơ!ƒĂ ăĂ!ƒ			
18	4.152	1.237	4.00	2.164	1.28	YĂdžŋdž!ƒ			
21	4.392	1.317	4.33	1.700	.76	ĸŰǴƮkŰƒĂ ĸǴǉĂƨƗ!Űƒ	YĂdžŋdž!ƒ		
23	4.189	1.242	4.22	2.120	1.30	ƗǒhƱ!ƒĂ ĸǴhƪǴơ!ƒĂ ăĂ!ƒ			
44	4.291	1.264	4.27	1.928	1.05	YĂdžŋdž!ƒ			
10	3.339	1.838	3.40	2.415	1.50	ĸŰǴƮkŰƒĂ ĸǴǉĂƨƗ!Űƒ	ƨƗƦ	ƗƱhǴư	
11	3.305	2.063	3.36	2.023	.91	ƗǒhƱ!ƒĂ ĸǴhƪǴơ!ƒĂ ăĂ!ƒ			
21	3.322	1.910	3.38	2.182	1.19	YĂdžŋdž!ƒ			
11	4.087	1.640	4.09	1.844	1.00	ĸŰǴƮkŰƒĂ ĸǴǉĂƨƗ!Űƒ	Ĭλip		
12	3.098	2.065	3.08	1.946	.83	ƗǒhƱ!ƒĂ ĸǴhƪǴơ!ƒĂ ăĂ!ƒ			
23	3.593	1.903	3.57	1.857	.91	YĂdžŋdž!ƒ			
21	3.713	1.729	3.76	2.095	1.24	ĸŰǴƮkŰƒĂ ĸǴǉĂƨƗ!Űƒ	YĂdžŋdž!ƒ		
23	3.202	2.022	3.22	1.938	.87	ƗǒhƱ!ƒĂ ĸǴhƪǴơ!ƒĂ ăĂ!ƒ			
44	3.457	1.886	3.48	1.999	1.05	YĂdžŋdž!ƒ			
25	3.906	1.620	4.04	2.107	1.24	ĸŰǴƮkŰƒĂ ĸǴǉĂƨƗ!Űƒ	ƨƗƦ	YĂdžŋdž	
22	3.845	1.743	3.91	1.771	.77	ƗǒhƱ!ƒĂ ĸǴhƪǴơ!ƒĂ ăĂ!ƒ			
47	3.875	1.661	3.98	1.950	1.02	YĂdžŋdž!ƒ			
17	4.199	1.478	4.06	1.539	.65	ĸŰǴƮkŰƒĂ ĸǴǉĂƨƗ!Űƒ	Ĭλip		
24	3.546	1.744	3.54	2.223	1.38	ƗǒhƱ!ƒĂ ĸǴhƪǴơ!ƒĂ ăĂ!ƒ			
41	3.873	1.640	3.76	1.980	1.07	YĂdžŋdž!ƒ			
42	4.053	1.545	4.05	1.900	1.00	ĸŰǴƮkŰƒĂ ĸǴǉĂƨƗ!Űƒ	YĂdžŋdž!ƒ		
46	3.695	1.734	3.72	2.020	1.09	ƗǒhƱ!ƒĂ ĸǴhƪǴơ!ƒĂ ăĂ!ƒ			
88	3.874	1.646	3.88	1.953	1.05	YĂdžŋdž!ƒ			
15	3.270	.737	3.40	1.363	1.00	ĸŰǴƮkŰƒĂ ĸǴǉĂƨƗ!Űƒ	ƨƗƦ	ƗǒhőƧŋk	DžƒƀƤkƪƒ lƨnjŋŬƒ
11	3.738	.405	3.82	1.214	.55	ƗǒhƱ!ƒĂ ĸǴhƪǴơ!ƒĂ ăĂ!ƒ			
26	3.504	.643	3.58	1.297	.81	YĂdžŋdž!ƒ			
6	3.938	.408	3.83	.548	.50	ĸŰǴƮkŰƒĂ ĸǴǉĂƨƗ!Űƒ	Ĭλip		
12	3.607	.651	3.67	1.775	1.67	ƗǒhƱ!ƒĂ ĸǴhƪǴơ!ƒĂ ăĂ!ƒ			
18	3.772	.575	3.72	1.565	1.28	YĂdžŋdž!ƒ			
21	3.604	.680	3.52	1.195	.86	ĸŰǴƮkŰƒĂ ĸǴǉĂƨƗ!Űƒ	YĂdžŋdž!ƒ		
23	3.673	.541	3.74	1.604	1.13	ƗǒhƱ!ƒĂ ĸǴhƪǴơ!ƒĂ ăĂ!ƒ			
44	3.638	.613	3.64	1.414	1.00	YĂdžŋdž!ƒ			
10	2.786	1.494	2.70	1.647	1.40	ĸŰǴƮkŰƒĂ ĸǴǉĂƨƗ!Űƒ	ƨƗƦ	ƗƱhǴư	
11	2.653	1.635	2.45	1.375	.91	ƗǒhƱ!ƒĂ ĸǴhƪǴơ!ƒĂ ăĂ!ƒ			

ÞÞž!ƒ	Ʊʅ Ăķďž!ƒ ýÞžďž!ƒ	Ĭ Þžħ!ƒ		Ŏŀħ!ƒ		ƒ Ţ Ƥķ!ƒ	Ʃ ļŋ!ƒ	ŧļöƧƱ!ƒ	
		ƻƒƧơļŰƒ Ĭ ƧĈöžďž!ƒ	Ʊʅ Ăķďž!ƒ ŎħĈʅơ!ƒ	ƻƒƧơļŰƒ Ĭ ƧĈöžďž!ƒ	Ʊʅ Ăķďž!ƒ ŎħĈʅơ!ƒ				
21	2.720	1.535	2.57	1.493	1.14	ƳĂďŋďž!ƒ			
11	3.140	.874	3.18	1.446	.91	ĸŬĆ Ţ ķŬƒĂ ĸĈöŀĂ Ƨķ‡!Ŭƒ	Ĭ ʎ ļþ		
12	2.361	1.614	2.33	1.337	.83	ŧöħƱ!ƒĂ ĸĈħ ʅĈơ!ƒĂ ăĂ!ƒ			
23	2.750	1.356	2.74	1.359	.87	ƳĂďŋďž!ƒ			
21	2.963	1.203	2.95	1.526	1.14	ĸŬĆ Ţ ķŬƒĂ ĸĈöŀĂ Ƨķ‡!Ŭƒ	ƳĂďŋďž!ƒ		
23	2.507	1.588	2.39	1.325	.87	ŧöħƱ!ƒĂ ĸĈħ ʅĈơ!ƒĂ ăĂ!ƒ			
44	2.735	1.430	2.66	1.414	1.00	ƳĂďŋďž!ƒ			
25	3.028	1.130	3.12	1.463	1.16	ĸŬĆ Ţ ķŬƒĂ ĸĈöŀĂ Ƨķ‡!Ŭƒ	Ƨ‡Ʀ	ƳĂďŋďž	
22	3.196	1.356	3.14	1.279	.73	ŧöħƱ!ƒĂ ĸĈħ ʅĈơ!ƒĂ ăĂ!ƒ			
47	3.112	1.227	3.13	1.382	.96	ƳĂďŋďž!ƒ			
17	3.539	.795	3.41	1.200	.76	ĸŬĆ Ţ ķŬƒĂ ĸĈöŀĂ Ƨķ‡!Ŭƒ	Ĭ ʎ ļþ		
24	2.984	1.383	3.00	1.595	1.25	ŧöħƱ!ƒĂ ĸĈħ ʅĈơ!ƒĂ ăĂ!ƒ			
41	3.261	1.181	3.17	1.448	1.05	ƳĂďŋďž!ƒ			
42	3.284	1.008	3.24	1.361	1.00	ĸŬĆ Ţ ķŬƒĂ ĸĈöŀĂ Ƨķ‡!Ŭƒ	ƳĂďŋďž!ƒ		
46	3.090	1.357	3.07	1.461	1.00	ŧöħƱ!ƒĂ ĸĈħ ʅĈơ!ƒĂ ăĂ!ƒ			
88	3.187	1.199	3.15	1.406	1.00	ƳĂďŋďž!ƒ			
15	2.992	1.125	2.87	.737	.60	ĸŬĆ Ţ ķŬƒĂ ĸĈöŀĂ Ƨķ‡!Ŭƒ	Ƨ‡Ʀ	ŧöħöƧŋķ	ÞöÞơķ ýĆƱŽŬƒ
11	3.112	.982	3.18	.688	.45	ŧöħƱ!ƒĂ ĸĈħ ʅĈơ!ƒĂ ăĂ!ƒ			
26	3.052	1.058	3.00	.706	.54	ƳĂďŋďž!ƒ			
6	2.627	1.169	2.83	.548	.50	ĸŬĆ Ţ ķŬƒĂ ĸĈöŀĂ Ƨķ‡!Ŭƒ	Ĭ ʎ ļþ		
12	3.008	1.165	2.92	1.165	1.08	ŧöħƱ!ƒĂ ĸĈħ ʅĈơ!ƒĂ ăĂ!ƒ			
18	2.817	1.132	2.89	1.023	.89	ƳĂďŋďž!ƒ			
21	2.809	1.108	2.86	.676	.57	ĸŬĆ Ţ ķŬƒĂ ĸĈöŀĂ Ƨķ‡!Ŭƒ	ƳĂďŋďž!ƒ		
23	3.060	1.065	3.04	.998	.78	ŧöħƱ!ƒĂ ĸĈħ ʅĈơ!ƒĂ ăĂ!ƒ			
44	2.935	1.077	2.95	.857	.68	ƳĂďŋďž!ƒ			
10	1.893	1.229	1.80	.675	.70	ĸŬĆ Ţ ķŬƒĂ ĸĈöŀĂ Ƨķ‡!Ŭƒ	Ƨ‡Ʀ	ŧƱħĆ ư	
11	1.776	1.514	1.91	.688	.55	ŧöħƱ!ƒĂ ĸĈħ ʅĈơ!ƒĂ ăĂ!ƒ			
21	1.835	1.352	1.86	.669	.62	ƳĂďŋďž!ƒ			
11	2.743	1.104	2.73	1.027	.64	ĸŬĆ Ţ ķŬƒĂ ĸĈöŀĂ Ƨķ‡!Ŭƒ	Ĭ ʎ ļþ		
12	1.700	1.288	1.75	.793	.58	ŧöħƱ!ƒĂ ĸĈħ ʅĈơ!ƒĂ ăĂ!ƒ			
23	2.221	1.278	2.22	.891	.61	ƳĂďŋďž!ƒ			
21	2.318	1.231	2.29	.856	.67	ĸŬĆ Ţ ķŬƒĂ ĸĈöŀĂ Ƨķ‡!Ŭƒ	ƳĂďŋďž!ƒ		
23	1.738	1.370	1.83	.728	.57	ŧöħƱ!ƒĂ ĸĈħ ʅĈơ!ƒĂ ăĂ!ƒ			
44	2.028	1.311	2.05	.784	.61	ƳĂďŋďž!ƒ			
25	2.443	1.261	2.44	.700	.64	ĸŬĆ Ţ ķŬƒĂ ĸĈöŀĂ Ƨķ‡!Ŭƒ	Ƨ‡Ʀ	ƳĂďŋďž	
22	2.444	1.405	2.55	.673	.50	ŧöħƱ!ƒĂ ĸĈħ ʅĈơ!ƒĂ ăĂ!ƒ			
47	2.443	1.317	2.49	.683	.57	ƳĂďŋďž!ƒ			
17	2.685	1.091	2.76	.870	.59	ĸŬĆ Ţ ķŬƒĂ ĸĈöŀĂ Ƨķ‡!Ŭƒ	Ĭ ʎ ļþ		
24	2.354	1.341	2.33	1.007	.83	ŧöħƱ!ƒĂ ĸĈħ ʅĈơ!ƒĂ ăĂ!ƒ			
41	2.519	1.247	2.51	.949	.73	ƳĂďŋďž!ƒ			
42	2.564	1.192	2.57	.764	.62	ĸŬĆ Ţ ķŬƒĂ ĸĈöŀĂ Ƨķ‡!Ŭƒ	ƳĂďŋďž!ƒ		
46	2.399	1.361	2.43	.871	.67	ŧöħƱ!ƒĂ ĸĈħ ʅĈơ!ƒĂ ăĂ!ƒ			

ƀƀƶ!ƒ	ƱʅĂƙdž!ƒ ýƀƶdž!ƒ	ĭƀƶŀ!ƒ		Ŏǘŀ!ƒ		ƒ ƮƤƙ!ƒ	Ʃǔŋ!ƒ	ƗƖőƧƱ!ƒ	
		ƻƒƧơǔŰƒ ĭƧƠőƶdž!ƒ	ƱʅĂƙdž!ƒ ŎŀƠʅơ!ƒ	ƻƒƧơǔŰƒ ĭƧƠőƶdž!ƒ	ƱʅĂƙdž!ƒ ŎŀƠʅơ!ƒ				
88	2.481	1.278	2.50	.817	.65	ÝĂdžŋdž!ƒ			
15	2.588	1.981	2.73	2.059	1.33	ƘŬƠƮƙŬƒĂ ƘƠǚĂƧƙƗŬƒ	ƧƗƘ	ƗŏŀőƧŋƙ	ƒ ǖƤƙʅƒ ƝƑƠƙǖ!ƒ
11	3.054	1.758	2.91	2.049	1.00	ƗŏƱ!ƒĂ ƘƠŀʅƠơ!ƒĂ ăĂ!ƒ			
26	2.821	1.855	2.81	2.020	1.19	ÝĂdžŋdž!ƒ			
6	2.777	1.835	2.17	.548	.50	ƘŬƠƮƙŬƒĂ ƘƠǚĂƧƙƗŬƒ	Ĭʎǖ		
12	2.930	1.730	3.58	2.563	2.25	ƗŏƱ!ƒĂ ƘƠŀʅƠơ!ƒĂ ăĂ!ƒ			
18	2.853	1.844	3.11	2.249	1.67	ÝĂdžŋdž!ƒ			
21	2.682	1.912	2.57	1.786	1.10	ƘŬƠƮƙŬƒĂ ƘƠǚĂƧƙƗŬƒ	ÝĂdžŋdž!ƒ		
23	2.992	1.738	3.26	2.367	1.65	ƗŏƱ!ƒĂ ƘƠŀʅƠơ!ƒĂ ăĂ!ƒ			
44	2.837	1.835	2.93	2.104	1.39	ÝĂdžŋdž!ƒ			
10	1.411	2.224	1.50	1.989	1.20	ƘŬƠƮƙŬƒĂ ƘƠǚĂƧƙƗŬƒ	ƧƗƘ	ƗƱŀƠư	
11	2.178	1.991	1.82	1.214	.55	ƗŏƱ!ƒĂ ƘƠŀʅƠơ!ƒĂ ăĂ!ƒ			
21	1.795	2.058	1.67	1.621	.86	ÝĂdžŋdž!ƒ			
11	1.892	2.587	1.91	1.844	1.00	ƘŬƠƮƙŬƒĂ ƘƠǚĂƧƙƗŬƒ	Ĭʎǖ		
12	1.241	1.165	1.08	1.528	.83	ƗŏƱ!ƒĂ ƘƠŀʅƠơ!ƒĂ ăĂ!ƒ			
23	1.566	1.974	1.48	1.649	.91	ÝĂdžŋdž!ƒ			
21	1.652	2.369	1.71	1.868	1.10	ƘŬƠƮƙŬƒĂ ƘƠǚĂƧƙƗŬƒ	ÝĂdžŋdž!ƒ		
23	1.709	1.619	1.43	1.363	.70	ƗŏƱ!ƒĂ ƘƠŀʅƠơ!ƒĂ ăĂ!ƒ			
44	1.680	1.993	1.57	1.617	.89	ÝĂdžŋdž!ƒ			
25	1.999	2.127	2.24	1.990	1.28	ƘŬƠƮƙŬƒĂ ƘƠǚĂƧƙƗŬƒ	ƧƗƘ	ÝĂdžŋdž	
22	2.616	1.916	2.36	1.660	.77	ƗŏƱ!ƒĂ ƘƠŀʅƠơ!ƒĂ ăĂ!ƒ			
47	2.308	2.010	2.30	1.841	1.04	ÝĂdžŋdž!ƒ			
17	2.335	2.291	2.00	1.510	.82	ƘŬƠƮƙŬƒĂ ƘƠǚĂƧƙƗŬƒ	Ĭʎǖ		
24	2.085	1.926	2.33	2.187	1.54	ƗŏƱ!ƒĂ ƘƠŀʅƠơ!ƒĂ ăĂ!ƒ			
41	2.210	2.064	2.20	1.947	1.24	ÝĂdžŋdž!ƒ			
42	2.167	2.170	2.14	1.805	1.10	ƘŬƠƮƙŬƒĂ ƘƠǚĂƧƙƗŬƒ	ÝĂdžŋdž!ƒ		
46	2.351	1.900	2.35	1.970	1.17	ƗŏƱ!ƒĂ ƘƠŀʅƠơ!ƒĂ ăĂ!ƒ			
88	2.259	2.024	2.25	1.883	1.14	ÝĂdžŋdž!ƒ			
15	18.707	2.769	18.67	7.206	5.73	ƘŬƠƮƙŬƒĂ ƘƠǚĂƧƙƗŬƒ	ƧƗƘ	ƗŏŀőƧŋƙ	ƗŋƧƀ!ƒ ƗőǙƗ!ƒ
11	20.440	2.136	20.18	6.935	4.09	ƗŏƱ!ƒĂ ƘƠŀʅƠơ!ƒĂ ăĂ!ƒ			
26	19.573	2.589	19.31	7.000	5.04	ÝĂdžŋdž!ƒ			
6	18.892	3.077	18.67	4.457	4.33	ƘŬƠƮƙŬƒĂ ƘƠǚĂƧƙƗŬƒ	Ĭʎǖ		
12	18.951	2.541	19.50	9.824	10.17	ƗŏƱ!ƒĂ ƘƠŀʅƠơ!ƒĂ ăĂ!ƒ			
18	18.922	2.669	19.22	8.735	8.22	ÝĂdžŋdž!ƒ			
21	18.800	2.781	18.67	6.460	5.33	ƘŬƠƮƙŬƒĂ ƘƠǚĂƧƙƗŬƒ	ÝĂdžŋdž!ƒ		
23	19.696	2.329	19.83	8.930	7.26	ƗŏƱ!ƒĂ ƘƠŀʅƠơ!ƒĂ ăĂ!ƒ			
44	19.248	2.591	19.27	7.820	6.34	ÝĂdžŋdž!ƒ			
10	13.992	6.408	14.20	8.249	7.60	ƘŬƠƮƙŬƒĂ ƘƠǚĂƧƙƗŬƒ	ƧƗƘ	ƗƱŀƠư	
11	13.713	6.439	13.64	6.991	5.45	ƗŏƱ!ƒĂ ƘƠŀʅƠơ!ƒĂ ăĂ!ƒ			
21	13.853	6.268	13.90	7.501	6.48	ÝĂdžŋdž!ƒ			
11	17.489	4.388	17.36	7.778	5.09	ƘŬƠƮƙŬƒĂ ƘƠǚĂƧƙƗŬƒ	Ĭʎǖ		

ββz!f	ʊʅĂƙdž!f ýβzdž!f	ĭβzh!f		Ŏllh!f		f ŢƤk!f	ΣǉŋQ!f	ŧǀőƧʊ!f	
		ƻfƧơǉŬf ĭƧǴőzdž!f	ʊʅĂƙdž!f ŎhǴʅơ!f	ƻfƧơǉŬf ĭƧǴőzdž!f	ʊʅĂƙdž!f ŎhǴʅơ!f				
12	13.054	5.728	12.92	6.994	5.00	ŧőhʊ!fĂ ƘǴhʅǴơ!fĂ ăĂǀ!f			
23	15.271	5.506	15.04	7.208	5.04	YĂdžŋdž!f			
21	15.740	5.543	15.86	7.907	6.29	ƘŬǴŢƙŬfĂ ƘǴőǉĂƧƙŧ!Ŭf	YĂdžŋdž!f		
23	13.384	5.948	13.26	6.835	5.22	ŧőhʊ!fĂ ƘǴhʅǴơ!fĂ ăĂǀ!f			
44	14.562	5.841	14.50	7.299	5.73	YĂdžŋdž!f			
25	16.349	4.986	16.88	7.528	6.48	ƘŬǴŢƙŬfĂ ƘǴőǉĂƧƙŧ!Ŭf	Ƨŧʀ	YĂdžŋdž	
22	17.077	5.756	16.91	6.831	4.77	ŧőhʊ!fĂ ƘǴhʅǴơ!fĂ ăĂǀ!f			
47	16.713	5.301	16.89	7.184	5.68	YĂdžŋdž!f			
17	18.191	3.925	17.82	6.645	4.82	ƘŬǴŢƙŬfĂ ƘǴőǉĂƧƙŧ!Ŭf	Ĭƛǉ		
24	16.003	5.485	16.21	8.747	7.58	ŧőhʊ!fĂ ƘǴhʅǴơ!fĂ ăĂǀ!f			
41	17.097	4.910	16.88	7.972	6.44	YĂdžŋdž!f			
42	17.270	4.559	17.26	7.147	5.81	ƘŬǴŢƙŬfĂ ƘǴőǉĂƧƙŧ!Ŭf	YĂdžŋdž!f		
46	16.540	5.565	16.54	7.931	6.24	ŧőhʊ!fĂ ƘǴhʅǴơ!fĂ ăĂǀ!f			
88	16.905	5.093	16.89	7.527	6.03	YĂdžŋdž!f			

ŧùőƧǴőzdž!f ƘǴù5fƧơǉŬfĂ ŧőhǴʅùơ!f ƘǴʊùʅĂƙdž!f Ŏ5 ƂőƧǊǴʊ ƂǉőǴhƙ (23) ýĂβŋ!f ǇőhŐ ƘfƧùőʒƙdž! Ƃzhƙ ŧőǀdžz!f ƘfƧǴǌdž!f ƧǴhƙƤf ĬǀƵ ŧőǉĂƧƙŧ!Ŭf ŧʅβǉǌ!f ŧhǀʊ ƇfβŰ ŧ!βzdž!f ƘǴʊʅĂƙdž!fĂ ŧùőǀdžz!f ƘfƧǴùǌdžǀ! ýβùzdž!f ŎhǴʅùơ!f ʊʅĂƙdž!f ƩǀhŧőơÜf ŢƤk!fĂ ΣǉŋQ!fĂ ΣőƧβk!f ŧǀőƧʊ ΣǉùŋQ!Ă Ü19.248 (Ŏùưfƙ5ŬfƧùhƙƤdž!f ŧùǀőƧʊ) ŧùőhőƧŋk!f ŧùƵĂdžŋdž!f ƠǃǴŢù! ŧʅdžƤ!f f ŢùƤkǀ!Ă Ü(18.80 ƘŬǴŢƙŬfĂ ƘǴőǉĂƧƙŧ!Ŭf) Ɖ f ŢƤkǀ!Ă Ü(18.92 ŧǴǉǫĂ Ü19.57ƧĂŧʀ) ŧƵĂdžŋdž!f ƠǃǴŢ! ýβzdž!f ŎhǴʅơ!f ʊʅĂƙdž!f ƩǀhǇőŋ Ŏ5 .(19.70 ŧőhʊ!fĂ ƘǴhʅǴơ!fĂ ăĂǀ!f) Ɣ Ɖ f ŢƤkǀ!Ă Ü(15.27 ŧǴǉƊĂ Ü13.85.ƧĂŧʀ) ΣǉŋQ!Ă .14.562 (ŧőβǴőƙƵŬf ŧǀőƧʊ!f) ŧʊhǴư!f ǇǴőh!Ă Ü(13.38 ŧőhʊ!fĂ ƘǴhʅǴơ!fĂ ăĂǀ!f) Ɣ f ŢƤkǀ!Ă Ü(15.74 ƘŬǴŢƙŬfĂ ƘǴőǉĂƧƙŧ!Ŭf) ƔơǴŢùdž!f ŎƑǴùǉƛ!f ǇőǴhƙ!f ýőǀơƙ ǅfβƤƙʅf ǅƙ ŧőhǴʅơ!f ƘǴʊʅĂƙdž!f ǇőhŧőƑǴŢơŬf ƽĂƧƼ!f ŧ!Ŭβ .(25) ýĂβŋ ŧőǀŧ!f ŧŋƧβǀ! ƔơǴŢdž!f ŎƛŭƛQ!f ǇőǴhƙ!f ýőǀơƙĂ Ü(24) ýĂβŋ ƘŬǴŋdžǀ! ββzƙdž!f

ƒNǉdžǏĜ ǖYƑƺƗǁǋ ţ ƮƠǁǋ ƧdžƜǁǋ ƧǏƥơƗǁ ƙƽǏƥƯ ƥƙǗ ơơƴƗDžǁ ƒƟƑƮDžǁ ǏƏƒǚƙǁ DžǉƑĜƗǁ ǖǏƗƟƗ **.24** ǖNjơƜ
ƙǉYƥƺǁ ǀƐƥƒNJDžǁ ǀǗƑƜDž ĂƗY ƙƨƐƥơǁ ƙdžǏY ơƐƥƺƈ ƃƐơǗ

Dïησ Ƨλǖf	Ɨ!Ǘƥ!f ƗőƑĜƮơǗf	ƻ Ɨdžőp	Ʊʅ Ăkdž ƘĜǌƧdž!f	ƘĜηƧƥ ƗőƧơ!f	YĂdžηdž ƘĜǌƧdž!f	ƘǗĜηdž!f	ǇǉĜǖk!f ƧƥƮdž
.024	.175	1.873	3.497	(5Ã1)	3.497	ýƱl!f ƨĜőƙƤį Ɨƅʅ ĜǉdžƗ!f lƨnjηǛfĂ	(Ŏǚǚl!f) ƔơĜƮdž!f
.045	.065	3.508	8.788	(5Ã1)	8.788	ýŏƮĂk!f	(Ŏǚǚl!f) ƔơĜƮdž!f
.006	.489	.483	.602	(5Ã1)	.602	lƨnjηǛf DžfƥƤkʅ ƪ	(Ŏǚǚl!f) ƔơĜƮdž!f
.025	.167	1.945	2.691	(5Ã1)	2.691	ýĜƱƵǛf ƥőƥơƙ	(Ŏǚǚl!f) ƔơĜƮdž!f
.022	.197	1.692	4.019	(5Ã1)	4.019	ƝƑĜƙǉ!f ƒ ǖƤƙʅf	(Ŏǚǚl!f) ƔơĜƮdž!f
.074	.016	6.030	11.261	1	11.261	ýƱl!f ƨĜőƙƤį Ɨƅʅ ĜǉdžƗ!f lƨnjηǛfĂ	ƗlőƧƱ!f
.061	.031	4.850	12.152	1	12.152	ýŏƮĂk!f	.308= ƝǉǚƙĂǋ
.133	.001	11.460	14.279	1	14.279	lƨnjηǛf DžfƥƤkʅ ƪ	.002=Ɵ
.122	.002	10.403	14.388	1	14.388	ýĜƱƵǛf ƥőƥơƙ	
.116	.002	9.860	23.413	1	23.413	ƝƑĜƙǉ!f ƒ ǖƤƙʅf	
.019	.237	1.420	2.652	1	2.652	ýƱl!f ƨĜőƙƤį Ɨƅʅ ĜǉdžƗ!f lƨnjηǛfĂ	Σǉη!f
.000	.994	.000	.000	1	.000	ýŏƮĂk!f	.037= ƝǉǚƙĂǋ
.005	.550	.360	.449	1	.449	lƨnjηǛf DžfƥƤkʅ ƪ	.761=Ɵ
.001	.773	.084	.116	1	.116	ýĜƱƵǛf ƥőƥơƙ	
.001	.777	.081	.192	1	.192	ƝƑĜƙǉ!f ƒ ǖƤƙʅf	
.013	.316	1.017	1.899	1	1.899	ýƱl!f ƨĜőƙƤį Ɨƅʅ ĜǉdžƗ!f lƨnjηǛfĂ	ƒ ƮƤk!f
.014	.313	1.030	2.580	1	2.580	ýŏƮĂk!f	.025= ƝǉǚƙĂǋ
.008	.437	.610	.760	1	.760	lƨnjηǛf DžfƥƤkʅ ƪ	.876=Ɵ
.005	.530	.398	.550	1	.550	ýĜƱƵǛf ƥőƥơƙ	
.004	.593	.287	.683	1	.683	ƝƑĜƙǉ!f ƒ ǖƤƙʅf	
.027	.152	2.094	3.910	1	3.910	ýƱl!f ƨĜőƙƤį Ɨƅʅ ĜǉdžƗ!f lƨnjηǛfĂ	Σǉη!f * ƗlőƧƱ!f
.007	.465	.540	1.353	1	1.353	ýŏƮĂk!f	.946= Σ ƗǚőĂ
.003	.652	.205	.255	1	.255	lƨnjηǛf DžfƥƤkʅ ƪ	.551=Ɵ
.017	.265	1.261	1.744	1	1.744	ýĜƱƵǛf ƥőƥơƙ	
.002	.720	.130	.308	1	.308	ƝƑĜƙǉ!f ƒ ǖƤƙʅf	

Ďiŋơ ƨƛŰƒ	Ɨ!Ǚþ!ƒ ƗŏƑƓƮơŰƒ	ƻ Ɨďžŏp	ƱƮĂƙdž ƘƓžƕƨdž!ƒ	ƘƓŋƨþ ƗŏƨƠ!ƒ	YĂdžŋdž ƘƓžƕƨdž!ƒ	ƘŮƓŋdž!ƒ	ǈŏǴƙ!ƒ ƨþƮdž
.035	.103	2.719	5.076	1	5.076	ýƠI!ƒ ƨĞŏƙƤƒ Ɨƕƪƙǉdž!ƒ ǉƨǌŋŮƒĂ	* ƗIŏƨƠ!ƒ ƒ ƮƤk!ƒ
.003	.666	.188	.472	1	.472	ýŏƮĂk!ƒ	.940= Σ ǂǁŏĂ
.014	.298	1.099	1.369	1	1.369	ǉƨǌŋŮƒ ĎƒþƤkƪƒ	.485=Θ
.032	.119	2.485	3.437	1	3.437	ýĞƠƵŮƒ þŏþơk	
.002	.717	.133	.315	1	.315	ǊƑĞkǉ!ƒ ƒ ŭƤkƪƒ	
.009	.400	.716	1.337	1	1.337	ýƠI!ƒ ƨĞŏƙƤƒ Ɨƕƪƙǉdž!ƒ ǉƨǌŋŮƒĂ	* Σǉŋ!ƒ ƒ ƮƤk!ƒ
.009	.409	.690	1.728	1	1.728	ýŏƮĂk!ƒ	.959= Σ ǂǁŏĂ
.027	.155	2.065	2.573	1	2.573	ǉƨǌŋŮƒ ĎƒþƤkƪƒ	.694=Θ
.005	.533	.392	.542	1	.542	ýĞƠƵŮƒ þŏþơk	
.020	.216	1.557	3.697	1	3.697	ǊƑĞkǉ!ƒ ƒ ŭƤkƪƒ	
.004	.578	.312	.583	1	.583	ýƠI!ƒ ƨĞŏƙƤƒ Ɨƕƪƙǉdž!ƒ ǉƨǌŋŮƒĂ	Σǉŋ!ƒ * ƗIŏƨƠ!ƒ ƒ ƮƤk!ƒ *
.004	.609	.264	.661	1	.661	ýŏƮĂk!ƒ	.948= Σ ǂǁŏĂ
.000	.878	.024	.030	1	.030	ǉƨǌŋŮƒ ĎƒþƤkƪƒ	.564=Θ
.017	.262	1.278	1.767	1	1.767	ýĞƠƵŮƒ þŏþơk	
.009	.424	.646	1.533	1	1.533	ǊƑĞkǉ!ƒ ƒ ŭƤkƪƒ	
			1.867	75	140.052	ýƠI!ƒ ƨĞŏƙƤƒ Ɨƕƪƙǉdž!ƒ ǉƨǌŋŮƒĂ	ǆƠƤ!ƒ
			2.505	75	187.900	ýŏƮĂk!ƒ	
			1.246	75	93.452	ǉƨǌŋŮƒ ĎƒþƤkƪƒ	
			1.383	75	103.727	ýĞƠƵŮƒ þŏþơk	
			2.375	75	178.100	ǊƑĞkǉ!ƒ ƒ ŭƤkƪƒ	
				87	174.864	ýƠI!ƒ ƨĞŏƙƤƒ Ɨƕƪƙǉdž!ƒ ǉƨǌŋŮƒĂ	Ŏǁǂ!ƒ
				87	235.625	ýŏƮĂk!ƒ	
				87	125.080	ǉƨǌŋŮƒ ĎƒþƤkƪƒ	
				87	142.000	ýĞƠƵŮƒ þŏþơk	
				87	356.500	ǊƑĞkǉ!ƒ ƒ ŭƤkƪƒ	

:ǑķǗf (24) ýǍþη!f ǇǆǅǇǒǉǩǒ

- ƘfƧǤǌǆǅ!f ƴǒǆǅη Ǒ5 ƗǀǒƧƱ!f ƧλǕ̄ ăƨƶķ (0.05 = α) ƗǒǊǤƬơȿ Ɨ!Ǖþ ƘfƦ ƾǍƧ5 þǍηǍ

Ɨ!fþ ƾǍƧ5 ƧǌǗǒ Ǳ! ǇǒơǑ5 ǗƗǒǉǒƧηķ!f ƗǀǒƧƱ!f ƠǃǤƬ! ƾǍƧ5!f ƘƇǤηǍ ǗƗǒǁǆƶ!f

ǗΣǉη!fǍ ƗǀǒƧƱ!f ǇǒǉǑǊǤǉλ!f ýƵǤ5ķ!f ƧλǕ̄Ǎ Ǘ f ƬƤķ!f ƧλǕ̄Ǎ ǗΣǉη!f ƧλǕ̄ ǕǒǊǤƬơƪ

Σǉη!f ǇǒǉǑǊǤǉλ!f ýƵǤ5ķ!f ƧλǕ̄Ǎ Ǘ f ƬƤķ!fǍ ƗǀǒƧƱ!f ǇǒǉǑǊǤǉλ!f ýƵǤ5ķ!f ƧλǕ̄Ǎ

. f ƬƤķ!fǍ Σǉη!fǍ ƗǀǒƧƱ!f ǇǒǉǑλǚλ!f ýƵǤ5ķ!f ƧλǕ̄Ǎ Ǘ f ƬƤķ!fǍ

ǘYƑƧƗǁǈǊ ţ ƬƢƗǁǈǊ Ƨ ǆƜǁǈǊ Ƨ ǐþơƗǁ ǉƽǐþƯ þķǓ ǉǐƗǀǁ ǉƜþơƗǁ ƒƟƑƬǅǁ Ǐķǘķǁ ǄǐƑǤƗǁ ǘǐƗƟƗ **.25** ǘǊǆơƜ

ǉǐƗǄǅƴǁ ǀƐþƑǊǄǅǁ þƑǤƗƢǁ ǍƗY ƑǊǆǐǤ

ƧλǕ̄f Ǳηơ	Ɨ!Ǖþ!f ƗǒǊǤƬơǗf	ƻ Ɨǆǒþ	Ʊȿ Ǎķǆ ƘǤƶǉƧǆ!f	ƘǤηƧþ ƗǒƧơ!f	YǍǆη ǆ ƘǤƶǉƧǆ!f	Ƨþ Ƭǆ!f
.051	.044	4.205	81.303	1	81.303	(ǑǉǀI!f) ƔơǤƬǆ!f
.229	.000	23.499	454.397	1	454.397	ƗǀǒƧƱ!f
.002	.693	.158	3.046	1	3.046	Σǉη!f
.007	.452	.571	11.034	1	11.034	f ƬƤķ!f
.014	.291	1.129	21.823	1	21.823	Σǉη!f Ã ƗǀǒƧƱ!f
.034	.098	2.800	54.147	1	54.147	f ƬƤķ!f Ã ƗǀǒƧƱ!f
.027	.140	2.218	42.899	1	42.899	f ƬƤķ!f Ã Σǉη!f
.005	.524	.409	7.906	1	7.906	ƬƤķ!fÃΣǉη!fÃƗǀǒƧƱ!f f
			19.337	79	1527.608	ǆƱƤ!f
				87	2256.864	YǍǆη ǆ!f

:ǑķǗf (25) ýǍþη!f ǇǆǅǇǒǉǩǒ

- ƠǃǤƬ! ƾǍƧ5!f ƘƇǤηǍ ǗƗƵǍǆη ǆ!f ƧλǕ̄ ăƨƶķ (0.05 = α) ƗǒǊǤƬơȿ Ɨ!Ǖþ ƘfƦ ƾǍƧ5 þǍηǍ

ƧλǕ̄Ǎ Ǘ f ƬƤķ!f ƧλǕ̄Ǎ ǗΣǉη!f ƧλǕ̄ ǕǒǊǤƬơƪ Ɨ!fþ ƾǍƧ5 ƧǌǗǒ Ǳ! ǇǒơǑ5 .ƗǒǉǒƧηķ!f ƗǀǒƧƱ!f

ƨƛŰĂ Ü ƒ ƮƤƙ!ƒĂ ƚlŏƨƱ!ƒ ǈŏƀ ŎƑƓǉƛ!ƒ ýƵƓƼƙ!ƒ ƨƛŰĂ ÜƩǉƞ!ƒĂ ƚlŏƨƱ!ƒ ǈŏƀ ŎƑƓǉƛ!ƒ ýƵƓƼƙ!ƒ

. ƒ ƮƤƙ!ƒĂ Ʃǉƞ!ƒĂ ƚlŏƨƱ!ƒ ǈŏƀ Ŏƛǚƛ!ƒ ýƵƓƼƙ!ƒ ƨƛŰĂ Ü ƒ ƮƤƙ!ƒĂ Ʃǉƞ!ƒ ǈŏƀ ŎƑƓǉƛ!ƒ ýƵƓƼƙ!ƒ

:ƚpǚƶ!ƒ ǅƒƥƤƙƪƓƀ Effect Size ƨƛŰƒ ǅƞơ ƥƓƞŏƺ ǅƙ ÜƚlŏƨƱ!ƒ ƚŏǈƵƓƼ ƥƓƞŏŰĂ

$\sqrt{[\eta^2/(1-\eta^2)]}$ Ü ƥl5 ƥƞĂ ǊǈƊ ŏƪƓĂ Ý(0.54) ƒƦǋĂ Ŏǉƶŏ ǈƊ ƨƱƚlŏƨ Ʃŏƨƥƙ!ƒ ƚŏǉƀƶ!ƒ ƵǈƮ

ƘƒƨƓƶƶ!ƒ ƔƓƪƙƚƒ Ŏ5 ǈŏƓƀƙ!ƒ ǈƶ (%54) Ŏ!ƒĂơ ƨƪƼƙ ŎưƒƨƙƼŰƒ ƨƀƙƤƶ!ƒ ƚlŏƨƱ ǅƒƥƤƙƪƒ

ƚƀŏƨƺ ýƶƒĂƵ Ŏ!ƥ ăƨƶŏĂ ƨƪƼƶ ƨŏƺ (%46) ǈŏƓƀƙ!ƒ Ŏ5 ŎpƓƀ!ƒ ƓƶǉŏƀÜ ƚƀƱ!ƒ ăƥ! ƚŏǈƶƶ!ƒ

.(ƚŏƞƨƓƤ Ƙƒƨƛƥƶ)

:ƀƨƐƥơǁƐ ƛƏƑƚƶ ƫ ƢƚǄ

:ŎƙŰƓƀ ƓǊƨƓƞŏƺ ǈƚƶŏ ǊǉƓ5 ƫƀƪ Ɠƶŏ5 ƚƪƒƨƥ!ƒ ǋƑƓƙǉ ƯƨƵ ƇĂư Ŏ5

ƚŏƪƥǉƞ!ƒ ǄŏǊƓƼƶ!ƒ ƔƓƪƙƚƒ - 1

ƘƓƱƪĂƙƶ ǈŏƀ (0.05 = α) ƚŏƑƓƮơƺ ƚ!Űƥ ǈƦ ƫƨ5 ƥĂƞĂ ƚƪƒƨƥ!ƒ ǋƑƓƙǉ ƘƨǌƜ

Ʊ!ƓƮ!Ă ÜƩŏƨƥƙ!ƒ ƚlŏƨƱ! ăƨƶŏ ǈƥƶ!ƒ ƚŏƪƥǉƞ!ƒ ǄŏǊƓƼƶ!ƒ ƔƓƪƙƚƒ ƨƓƀƤƒ Ŏ5 ƚƀƱ!ƒ ƘƓƶǚƵ

ǈŏƀ (0.05 = α) ƚŏƑƓƮơƺ ƚ!Űƥ ǈƦ ƫƨ5 ƥĂƞĂĂ Ü(ŎưƒƨƙƼŰƒ ƨƀƙƤƶ!ƒ) ƚŏƀŏƨƞƙ!ƒ ƚlŏƨƱ!ƒ

Ü ƒ ƮƤƙ! ăƨƶŏ ǈƥƶ!ƒ ƚŏƪƥǉƞ!ƒ ǄŏǊƓƼƶ!ƒ ƔƓƪƙƚƒ ƨƓƀƤƒ Ŏ5 ƚƀƱ!ƒ ƘƓƶǚƵ ƘƓƱƪĂƙƶ

= α) ƚŏƑƓƮơƺ ƚ!Űƥ ǈƦ ƫƨ5 ƥĂƞĂĂ Ü(ƘŰƓƮƙŰƒĂ ƘƓŏǉĂƨƙƚ!Űƒ) ǅ ƒ ƮƤƙ!ƒ Ʊ!ƓƮ!Ă

Ɠƶƚ . ƒ ƮƤƙ!ƒĂ ƚlŏƨƱ!ƒ ǈŏƀ ýƵƓƼƙ! ăƨƶƙ ǈƥƶ!ƒ ƚŏƶǈƶ!ƒ ǄŏǊƓƼƶ!ƒ ƔƓƪƙƚƒ ƨƓƀƤƒ Ŏ5 (0.05

ÜƩǉƞ!ƒ ǈƶ ýƚ ƨƛŰ ăƨƶƙ (0.05 = α) ƚŏƑƓƮơƺ ƚ!Űƥ ƘƒƫƨĂƥ5 ƥĂƞĂ ǅƥƵ ƐưŏǅƘƨǌƜ

ǅƥƵ ƐưŏǅƘƨǌƜĂ .ƩǉƞƒĂ ƒ ƮƤƙ!ƒĂ Ʃǉƞ!ƒĂ ƚlŏƨƱ!ƒ ǈƶ ýƚ ǈŏƀ ŎƑƓǉƛ!ƒ ýƵƓƼƙ!ƒ ƨƛŰĂ

ƩǉƞƒĂ ƚlŏƨƱ!ƒ ǈŏƀ Ŏƛǚƛ!ƒ ýƵƓƼƙ!ƒ ƨƛŰ ăƨƶƙ (0.05 = α) ƚŏƑƓƮơƺ ƚ!Űƥ ƘƒƫĂƥ5 ƥĂƞĂ

. ƒ ƮƤƙ!ƒĂ

þpǴǰ!ƒ Ƨŏǂƽƙ!ƒ ƘƒƧǴnjdž ƔǴƪƙǂƪ -2

ƘǴƱƪĂƙdž ǈǰǚ (0.05 = α) ƗŏƑǴƮơƾ Ɨ!Ǚþ ĭƦ ƾƧ5 þĂŋĂ ƗƪƒƧþ!ƒ ǋƑǴƙǰ ƘƧnjǓǅ

ƘƇǴŋĂ ǕƗŀŏƧƱ!ƒ ƧƛǕ ăƨƶƅ ĭþƶǜ!ƒ þpǴǰ!ƒ Ƨŏǂƽƙ!ƒ ƘƒƧǴnjdž ƔǴƪƙǂƪ ƧǴǚƘƤƪ Ŏ5 ƗǜǛƱ!ƒ ƘǴdžǖƵ

ƾĂƧ5 þĂŋĂ ǅþƵ ƗƪƒƧþ!ƒ ƘƧnjǓǅ Ǵdžǂ .(Ŏƣ ƒƧƙ5Ǚƒ ƧǚƙƤdž!ƒ) ƗŏǚŏƧŋƙ!ƒ ƗŀŏƧƱ!ƒ ƠǃǴƮ! ƾĂƧƽ!ƒ

ŎƑǴǰƛ!ƒ ýƵǴƽƙ!ƒ ƧƛǕĂ ƒ ƮƤƙ!ƒĂ Ʃǰŋ!ƒ ǈdž ýǂ ƧƛǕ ăƨƶƙ (0.05 = α) ƗŏƑǴƮơƾ Ɨ!Ǚþ ƘƒƦ

þĂŋĂ ǅþƵ ǴƣŏǅĂ ƘƧnjǓǅĂ . ƒ ƮƤƙ!ƒĂ ƩǰŋĂ!ƒ ƒ ƮƤƙ!ƒĂ ƗŀŏƧƱ!ƒĂ Ʃǰŋ!ƒĂ ƗŀŏƧƱ!ƒ ǈǰǚ

Ʃǰŋ!ƒĂ ƗŀŏƧƱ!ƒ ǈǰǚ ŎƛǖƛƒƧ ýƵǴƽƙ!ƒ ƧƛǕ ăƨƶƙ (0.05 = α) ƗŏƑǴƮơƾ Ɨ!Ǚþ ƘƒƦ ƾĂƧ5

. ƒ ƮƤƙ!ƒĂ

ƗŏǚdžƶƵ!ƒ ƘƒƧǴnjdž!ƒ ƔǴƪƙǂƪ -3

ƔǴƪƙǂƪ Ŏ5 (0.05 = α) ƗŏƑǴƮơƾ Ɨ!Ǚþ ĭƦ ƾƧ5 þĂŋĂ ƗƪƒƧþ!ƒ ǋƑǴƙǰ ƘƧnjǓǅ

ƗŏǚŏƧŋƙ!ƒ ƗŀŏƧƱ!ƒ ƠǃǴƮ! ƾĂƧƽ!ƒ ƘƇǴŋĂ ǕƗŀŏƧƱ!ƒ ƧƛǕ ăƨƶƅ ĭþƶǜ!ƒ ƗŏǚdžƶƵ!ƒ ƘƒƧǴnjdž!ƒ

= α) ƗŏƑǴƮơƾ Ɨ!Ǚþ ƘƒƦ ƾĂƧ5 þĂŋĂ ǅþƵ ǴƣŏǅĂ ƗƪƒƧþ!ƒ ƘƧnjǓǅĂ .(Ŏƣ ƒƧƙ5Ǚƒ ƧǚƙƤdž!ƒ)

Ă Ʃǰŋ!ƒĂ ƗŀŏƧƱ!ƒ ǈdž ýǂ ǈǰǚ ŎƑǴǰƛ!ƒ ýƵǴƽƙ!ƒĂ ƒ ƮƤƙ!ƒĂ Ʃǰŋ!ƒ ǈdž ýǂ ƧƛǕ ăƨƶƙ (0.05

Ɨ!Ǚþ ƘƒƦ ƾĂƧ5 þĂŋĂ ǅþƵ ǴƣŏǅĂ ƗƪƒƧþ!ƒ ƘƧnjǓǅĂ . ƒ ƮƤƙ!ƒĂ Ʃǰŋ!ƒĂ ƒ ƮƤƙ!ƒĂ ƗŀŏƧƱ!ƒ

. ƒ ƮƤƙ!ƒĂ Ʃǰŋ!ƒĂ ƗŀŏƧƱ!ƒ ǈǰǚ ŎƛǖƛƒƧ ýƵǴƽƙ!ƒ ƧƛǕ ăƨƶƙ (0.05 = α) ƗŏƑǴƮơƾ

Effect Size ƧƛǕƒ ǅŋơ ƔǴƪơ -4

ƔǴƪƙǂƪ Ŏ5 Effect Size ƧƛǕƒ ǅŋơ þǴŋŏǜǚ ǕƗŀŏƧƱ!ƒ ǰƦǋ ƗŏǜƵǴ5 ƗƪƒƧþ!ƒ ǋƑǴƙǰ ƘƧnjǓǅ

ĬǜƵ Ɨŏǰǚdž!ƒ ƩŏƧþƙ!ƒ ƗŀŏƧƱ ǈǅ Ŏǰƶŏ ƒƦǋĂ (0,52) ĭĂǴƪŏ ǈǴǂĂ ǕƗǜǛƱ!ƒ ăþ! ƗŏƪþǰŊ!ƒ ǅŏǋǴƽdž!ƒ

ƘƒƧǴnjdž ƔǴƪƙǂƪ Ŏ5Ă ǕǈǰǚǴǚƙ!ƒ ǈdž (%52) Ŏ!ƒĂơ Ƨƪƽƙ Ŏƣ ƒƧƙ5Ǚƒ ƧǚƙƤdž!ƒ ƗŀŏƧƱ ǅƒþƤƙƪƒ

Ŏ!ƒĂơ Ƨƪƽƙ ƗŀŏƧƱ!ƒ ǰƦǋ ǈǅ Ŏǰƶŏ ƒƦǋĂ (0.50) ĭĂǴƪŏ ƧƛǕƒ ǅŋơ ǈǴǂ ƗǜǛƱ!ƒ ăþ! þpǴǰ!ƒ Ƨŏǂƽƙ!ƒ

ĭĂǴƪŏ ƧƛǕƒ ǅŋơ ǈǴǂ þƗ5 ƗǜǛƱ!ƒ ăþ! ƗŏǚdžƶƵ!ƒ ƘƒƧǴnjdž!ƒ ƔǴƪƙǂƪ Ŏ5 ǴdžǅǕ ǈǰǚǴǚƙ!ƒ ǈdž (%50)

ƧƪƽƘ Ǒư ƒƧƙƽǕƒ ƧƕƘƤdž!ƒ ƗƖǒƧƱ DžƒƥƤƘƪƒ ǏƖƵ Ɨǒǉƕdž!ƒ Σǒƨƥƙ!ƒ ƗƖǒƧƱ LJƉ Ǒǉƶǒ ƒƦNjǍ (0.54)

Ǐ!ǫ ǎƨƶƘǍ ƖƧƪƽdž Ƨǒƹ LJǒƓƕƙ!ƒ Ǒƽ ƗǒƖƕƙdž!ƒ ƗǒǍƑdž!ƒ Ɨǒƪǉ!ƒ ƓdžǉǒƕƕǙLJǒƓƕƙ!ƒ LJdž (%54) Ǒ!ƒǍơ

.(ƗǒƞƧƓƤ ƘƒƧƛƋdž) ƗƕǒƧƹ ýdžƒǍƵ

الفصل الخامس

مناقشة النتائج والتوصيات

(Circuit Maker)

($0.05 = \alpha$)

[illegible]

(2005 ;2002 ; Postlethwaite, *et al*, 2005 ; Hung, 2003

.(Zacharia, 2007 ; Drofinik *et al*, 2001 ;Chi *et al*, 2001

(Jensen

et al, 2004

(0.05 = α)

(2)

(Circuit Maker)

(0.05 = α)

(α=0.05)

(Balmush & Dumbraveanu, 2005 ؛ Change, 2002 ؛ Keller & Keller, 2005 ؛

. Gokhale, 1996 ; Saànchez Athanasios, *et al*, 2012 *et al*, 2005)

(Circuit Maker)

($\mathbf{0.05} = \alpha$)

[illegible]

[illegible]

[illegible] (Cordel & Meinel, 2004 ؛ Bell & Fogler, 1999؛ Dillon, 2007 ؛Feisel, 2005)؛

[illegible] (2011 [illegible]

[illegible]

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[illegible]

[illegible]:

- [illegible] (1) [illegible]
  [illegible].
- [illegible]
  [illegible].
- [illegible] (Circuit Maker) [illegible]
  [illegible]
  [illegible].
- [illegible] (1) [illegible]
  [illegible]
  [illegible].
- [illegible]
  [illegible]

ʊɰɛþDžǁɛǋ þƣƑƬDžǁɛ ƕDžəƑƽ

:ƕĭƓþƴǁɛ ʊɰɛþDžǁɛ

ǈƗĭDžǆƗ ǈƗɛþƑǊDž ǈƗƴĭƓƲ ǈƻĭþƴƗ) ăǋƓþƗ þǋɥǆDž DžDž þĭǀƻǁɛ .(2005).ĭþηǆ Ü DžǒǋƒƧƕ

.ƖƧǋƓǀ!ƒ ÜƔƙǂ!ƒ DžǃƓƵ Ü(1)Ʊ Û(ǈƱƑDžǆƈ

ƕĭǋƸǁ ƕĭDžɰƴDž ƖƑƨɛþƣ :ƒþƴǁɛ DžƑƨǁ .(1996) .ǇǰþƑ ýƓǆη ýɯƽ!ƒ ĂƕD ÜƧĂʊǈǆ Ǉƕƍ

Ɨǒǆǀƶ!ƒ Ɣƙǂ!ƒ Ƨƒþ KishlīHikmat

Ƨĭþƣƚǁɛ ƖƑĭɰĭɛþƗƨƌ ƅǋƬ Ĭƺ !ǋǂƴǁɛ ƒþƑɰƚ Ƨĭþƣƚ Ĭƺ ƣĭƣɰǁɛ .(2005) .ǑơƕƬ ÜƗ!ǚη ĂƕD

.ƖþơǩǆƑ ƗǒƕƧƶ!ƒ ƘƒƧƓǆǗƒ Ɨ!Ăþ ÜƴǒƨĂǩ!ƒĂƧƬǈǀ! ɵǚƽ!ƒ Ɨƕǂǂǆ .ƔþƬƑƴDžǁɛ

ƧƬǈǀ! ɵǚƽ!ƒ Ɨƕǂǂǆ Ü(2)Ʊ .ƑǊƨĭþƣƗǋ ƕĭƨþƣDžǁɛ ƖƑĭƬƑĭþǁɛ ƛǉƑǆDž .(2003) .þǒƧƽ ÜǊǉǒƨ ĂƕD

.ƘǒĂǂ!ƒ ÜƴǒƨĂǩ!ƒĂ

ƑDž ƖɛþƑǊDž ƒ ƴƓ ƕĭDžǆƗǁ ƔƑǀƑɵDžǁɛ ƒǋǂƨƈ Ăǂϒ !əƑƽ Ĭǆƭƚ ƛDžƑǆþƓ .(2009) .ǑǈƓǋ ÜþĂƶʅ!ƒ ĂƕD

ƧǒǩʅηƓǆ Ɨ!ƓʅƧ ÜƔƦƸƓ ĬƨƑƨǕɛ ʊƨƑƚǁɛ ƺƬǁɛ ƕƓǂƱ ǌƣǁ !ǋǂƴǁɛ ƗƑǊǆDž Ĭƺ ƕƺþƴDžǁɛ ƅɛþǋ

.Ɩƨƺ ÜƗǒǆǚʅǗƒ Ɨƶǆƈη!ƒ ÜƗǒƕƧǩ!ƒ Ɨǒǀǂ .ƖƧĂƬǈǆ

!ǋǂƴǁɛǋ ƖƑĭƬƑĭþǂǁ ƕĭǁǋƣǁɛ ƕƨɛþƣǁɛ DžƳ ĬǆƣþǕɛ ĬǆƱǋǁɛ þĭþƭ!ƒ .(2007) .ƔƓƱƤ ÜǉþƕǃĂƕD

ƘƒƧĂƬǈǆ Ɨǀʅǀʅ ÜƗǒƧƬƕ!ƒ þƧƒĂǆ!ƒ Ɨǒǆǉǩ! ǑǈƱĂ!ƒ ƨǂƧǆ!ƒ .(TIMSS) 2007 !Ƒƴǁ

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Ɨ!Ɠʅ ƧǂƔƦƸƓ ĬƨƑƨǕɛ ʊƨƑƚǁɛ ƺƬǁɛ ƕƓǂƱ ǌƣǁ ƑɰǋǀǋǆƗǀƑƓ ƕĭƓþǊǀǁɛ ƖɛþƑǊDžǁɛǋ

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Ǐ ƺ DžĭƽNjƻŧDžǁƐ ƤĭDžǗŧǁƐ ǍŧƳ ƕĭƓĭƥƜŧ ƕ ƨ ƐƥƣǗ ǛƣƽƑǁƐ ƥĭ ǀ ƻŧǁƐNj ƀƐƥƘǕƐ .(2005) ƘƶƼƧ ǕƘƓƞnjƕ

.ƧƮǆ ǕƖƧNjƓǃ!ƒ ƔƘŧ!ƒ DžƓƵ Ǖ(2)Ʊ Ǖ ǏƏƐƣŧƓǕƐ Ƨ DžƑǋǁƐ ƺƬǁƐ

DžǒǁƶƘǁ! ŧǒƕƧƶ!ƒ ŧŧƕƬ!ƒ. ǏǆNjƥŧǀǁǕƐ !ĭŧƴŧǁƐ Ǐ ƺ ƕĭƽĭƓƢŧǁƐNj ƕĭŧDžƴǁƐ ƣƑƴƓǕƐ .(2006) .ƥǈnjǆ ǕǑƘƓǒƕ!ƒ

.ǇƥƧǕƒ ǕǇƓǆƵ ǕƥƶƕǇƵ DžǒǁƶƘ!ƒǍ ƟǍƘƽǆ!ƒ

Ǖ9 ƥǁƞǆ ǕƕĭƓƥƴǁƐ ƕĭƓƥŧǁƐ ǖƓƾƗƨDž ƕŧƜDž .DžǒǁƶƘ!ƒ ƧǒǍƱƘǍ ƖƓŧƓơǆ!ƒ. (2003) .ƟǗƮ ǕƾǒƼǍƘ

.311-245 Ǖ29ƥƥƶ!ƒ

ǕǇƓǆƵǕŧƵƓƱǁ! Ƨŧƽ!ƒ Ƨƒƥ Ǖ(3)Ʊ . ǀ ƑƾĭƓƢŧNj !ĭǉƑƻDž -ƥĭ ǀ ƻŧǁƐ !ĭŧƴŧ (2007) .ǑơƘƼ ǕǇƒǍƧƞ

.ǇƥƧǕƒ

ƕĭƻǁǗǁ ƕĭŧƓƾƗƨDž ǀƑĭƜĭƐƥŧƨƌ :ƥĭ ǀ ƻŧǁƐ !ĭŧƴŧ Ǐ ƺ ƕƘĭƣƟ ǀƑǉƑƜŧƌ .(2003). ĭ ƥƞǆ ǕƔǒƕơ

.ŧǒƕƧƶ!ƒ ƧƮǆ ŧǒƧǍnjǆƞ ǕƖƧNjƓǃ!ƒ ǕǑƕƧƶ!ƒ Ƨŧƽ!ƒ Ƨƒƥ Ǖ(1)Ʊ .ƔƣĭƣƜǁƐ

.DžĭƥƪƴǁƐNj ǎƣƑƟǁƐ DžƥƾǁƐ Ǐ ƺ Ǐ ƨ ƐƥƣǁƐ ǖƬƻǁƐ ǖƢǁƐƣ ƱƐƣƓǕƐ ƕĭDžǆŧ .(2007). ĭ ƥƞǆ ǕƔǒƕơ

.ŧǒƕƧƶ!ƒ ƧƮǆ ŧǒƧǍnjǆƞ ǕƖƧNjƓǃ!ƒǕ ǑƕƧƶ!ƒ Ƨŧƽ!ƒ Ƨƒƥ Ǖ(2)Ʊ

Ǖ(2)Ʊ .ƕĭƨĭƥƣŧ ǀƑĭƜĭƐƥŧƨƌNj ƕĭƥƜǆ Ƨ ƨƓ ƣƽƑǁƐ ƥĭ ǀ ƻŧǁƐNj ƕƸŧǁƐ .(2007) . ǑǁƵ ǕƾǗơ!ƒ

.ǇƓǆƵ ǛƴǒƨǍƘ!ƒǍ ƧƬǈǁ! ǀƧǒƪǆ!ƒ Ƨƒƥ ǕŧǆǒƶƱ ĭ ƥƬƧ DžǒƥǀƘ

ǖƟ ǀ ƐƥƑNJDž ƒƑƨŧǀƐ Ǐ ƺ !ƣƾŧDžǁƐ !ƢǆDžǁƐNj ƕĭDžŧƴǁƐ ƕƢƪǆǕƐ ǏŧƾĭƥƢ ƥƘƓ .(2005).ƥǆơǆ ǕƘƓƮƓơ

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.ǇƥƧǕƒ ǕǇƓǆƵ ǕƓǒǁƶ!ƒ ƘƓƪƒƧƥǁ! ŧǒƕƧƶ!ƒ ǇƓǆƵ ŧƶǆƓƞ ǕƖƧǍƬǈǆ Ƨǒƺ ǉƒƧǍƘŧƥ ŧơǍƧƱǛ

ǕǇǒƶ!ƒǕǑƶǆƓƞ!ƒ ƔƓŧ!ƒ Ƨƒƥ .ǇŧƑĭƜĭƐƥŧƨƐNj Ƨ ĭƥƣŧǁƐ ƼƏƐƥƢ .(2003) .ƥǆơǆ Ǖŧǁǒơ!ƒ

.ǀƥơƘǆ!ƒ ŧǒƕƧƶ!ƒ ƘƒƧƓǆǕƒ

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[illegible]

.120-101 [illegible] (9) 3 [illegible]

[illegible] .([illegible]) [illegible]

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[illegible] (2) [illegible] . (2008) [illegible]

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[illegible] (1) [illegible] .(2005) [illegible]

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[illegible] .(2005) [illegible]

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[illegible] .(2008) [illegible]

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.236 -181 [illegible] (8) **1** [illegible]

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ƧǒĂƱƘĂ ǅǒǆǎ Ƭƙ! ƚǆǤƶ!ƒ ƖƧƒƥǕƒ . ƒ ƨƑƟǁƑǴ ƕǐǆǋƥƚǁǁǕƐ ƥƏƐǋǫǁƐ !ǐǅƬƚ .(2008).ƥǆơǆ ÜǑǁǒơƪ!ƒ
:ǑǉĂƧƘƚ!Ǖƒ ƴƥĂǆ!ƒ .ƚǒƥĂƶƪ!ƒ ƚǒƅƧƶ!ƒ ƚƚǁǆǆǆ!ƒ ÜǋǋǴǉǆ!ƒ
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ǌǫǁ ƑǋƚǐǅǆƚǋƀƑǐǅǐǁǁƐ Ǐƺ ƕǐƚǅƴǁƐ ƖƐƥƑǋǅƚǁ ƕǐƺƥƴǅǁƐ ƒǆƐǋǉǁƐ !ǐǋƭƚ .(1990) ƖƥǒǴƵ ÜƧĂƧƪ
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جامعة اليرموك
YARMOUK UNIVERSITY

الرقم: ك ت/٢٠٢/١١٤ (٥٦٤)
التاريخ: جمادى الآخرة ١٤٣٤
الموافق: أيار/٢٠١٣

كلية التربية
مكتب العميد

جامعة اليرموك
كلية الحجاوي
٠٦ أيار ٢٠١٣
الرقم ٩٨٧

الأستاذ الدكتور رئيس الجامعة

الموضوع: تسهيل مهمة الطالب عمر علي حسين الحوارني

تحية طيبة وبعد ،،،

يقوم الطالب عمر علي حسين الحوارني، ورقمه الجامعي (٢٠١٠٢٣٠٠١٨)، بدراسة بعنوان "أثر المختبر الافتراضي في اكتساب المفاهيم الهندسية ومهارات التفكير الناقد والمهارات العملية لدى طلبة الهندسة الإلكترونية في جامعة اليرموك"؛ وذلك استكمالاً لمتطلبات الحصول على درجة الدكتوراه في التربية، تخصص مناهج العلوم وأساليب تدريسها، ويستدعي ذلك تطبيق أداة الدراسة (اختبار) على عينة من طلبة هندسة الإلكترونيات في كلية الحجاوي في الجامعة.

أرجو التكرم بالاطلاع والموافقة على تسهيل مهمة الطالب المذكور أعلاه.

وتفضلوا بقبول فائق الاحترام،،،

عميد كلية التربية

أ.د. امل خصاونة

عميد كلية الحجاوي
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لتسهيل مهمة الطالب لطفاً

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(Davis, 2012)

Resistor	A device used to control current in an electric circuit by providing resistance
Ground	In electrical engineering, ground or earth can refer to the reference point in an electrical circuit from which other voltages are measured, or a common return path for electric current, or a direct physical connection to the Earth.
DC Power supply	It is an electrical device that is used to produce various types of DC voltages
Potentiometer	It is a three-terminals electrical component resistor with a sliding contact that forms an adjustable and various values of resistances
Capacitor	A capacitor is a passive electronic component that stores energy in the form of an electrostatic field. In its simplest form, a capacitor consists of two conducting plates separated by an insulating material called the dielectric.
Diode	A diode is a specialized electronic component with two electrodes called the anode and the cathode The fundamental property of a diode is its tendency to conduct electric current in only one direction.
Zener Diode	A Zener diode is a diode which allows current to flow in the forward direction in the same manner as an ideal diode, but will also permit it to flow in the reverse direction when the voltage is above a certain value known as the breakdown voltage,
Transformer	Device that converts an alternating (A/C) current of a certain voltage to an alternating current of different voltage, without change of frequency, by electromagnetic induction.
Signal Generator	is an electronic device designed to produce different shapes of electrical signals with various values of voltages and frequencies, it is used to give an input device for the electronic circuit
Clipper circuit (Positive Clipper Negative Clipper)	It is a circuit that consists of linear elements like resistors and non-linear elements like diodes for clipping an (upper portion and/or lower portion of a sinusoidal voltage signal).
clamping circuit (Positive Clamper Negative Clamper)	It is a circuit that consists of linear elements like resistors and capacitors which add a DC voltage level level to the input a waveform. (upper portion and/or lower portion of a sinusoidal voltage signal).
Rectifiers	It is an electrical circuit that is usally contains a diode , resistor and capacitor which converts the alternating current (AC) to direct current (DC),
Half wave Rectifiers	a **rectifier** that changes only one **half** of a cycle(clipping the positive or negative cycle) then converts the alternating

	current (AC) to direct current (DC)
Full wave Rectifiers	a **rectifier** that changes the direction of only one **half** of a cycle(positive or negative cycle) then converts the alternating current (AC) to direct current (DC)
Bridge Rectifier	A type of full-wave **rectifier** with four diodes that converts both the positive and negative cycles of AC voltage to DC voltage
Ripple (%Ripple)	It can be defined as the variation of the amplitude of DC (Direct current) due to improper filtering of AC power supply. It can be measured by specific equations
Regulators	It is a circuit that is used to regulate (sustain a fixed DC value) for an output signal.
Transistor	A small electronic device containing a semiconductor and having at least three electrical contacts(base, collector and emitter), used in a circuit as an amplifier or a switch
Bipolar Junction Transistor(BJT)	is a type of transistor that relies on the contact of two types of semiconductor for its operation. BJTs can be used as amplifiers, switches, or in oscillators.
Field Effect Transistor(FET)	It is a unipolar transistor involves single-carrier-type operation. that uses an electric field to control the shape and hence the conductivity of a channel of one type of charge carrier in a semiconductor material.
Transistor Biasing	The transistor can be used in three regions (active ,saturation and cut off) the biasing is to chose and keep the point is to the transistor operating in the active mode for an amplifying the signal.
Voltage divider biasing	It is a self **bias** process of suitably **biasing** amplifier by connecting two resistors R_1 and R_2in series with the base terminal of transistor. The voltage across R_2 forward biases the emitter junction. By proper selection of resistors R_1 and R_2, the operating point of the transistor can be made independent of β.
Beta (β)	Beta of a **Transistor** Circuit. **β** (beta) is a specific value of the gain or amplification factor of a BJT **transistor** which is equal the collector current divided by the base current .
g_m	g_m of a **transistor** circuit is a trans conductance specific value of the amplification factor of a FET **transistor** which is equal the drain current, divided by the gate-source bias base voltage .
Amplifier	An electronic amplifier or (informally) amp is an electronic device/or circiut that has a transistor used to increases the amount of a signal by taking energy from a power supply and controlling the output to match the input signal shape but with a larger amplitude.
Common Base Amplifier	It is a BJT amplifier that is the base is connected to ground, or "common,". In this circuit the emitter terminal of the transistor serves as the input, the collector the output.
Common Emitter Amplifier	It is a BJT amplifier that is the emitter is connected to ground, or "common,". In this circuit the base terminal of the transistor serves as the input, the collector the output.

Common Collector Amplifier	It is a BJT amplifier that is the collector is connected to ground, or "common,". In this circuit the base terminal of the transistor serves as the input, the emitter the output.
Common Source Amplifier	It is a FET amplifier that is the source is connected to ground, or "common,". In this circuit the gate terminal of the transistor serves as the input, the drain the output.
Common Gate Amplifier	It is a FET amplifier that is the gate is connected to ground, or "common,". In this circuit the source terminal of the transistor serves as the input, the drain the output.
Common Drain Amplifier	It is a FET amplifier that is the drain is connected to ground, or "common,". In this circuit the gate terminal of the transistor serves as the input, the source the output.
Bypass capacitor	It is a capacitor that bypass any other signal in high frequency signsl
Oscilloscope	An instrument with usually 2-chanells used to measure the output of an electronic circuit and observe changes in electrical signals (the amplitude of the signal as it varies with time).
Digital Multimeter	An instrument of test circuits and equipment used for measuring voltage, current, resistance, and possibly other electircal quantities
Input Signal	The signal going into an electronic circuit as an input and it can be varied in different values of voltages and frequencies.
Output Signal	The signal taking from an electronic circuit as an output and it can take different values depending on the input signal and the circuit.
Input Frequency	The frequency of the input signal measured in KHz
Output Frequency	The frequency of the output signal measured in KHz
Peak-Peak Value.	The difference between maximum and minimum value of the voltage of the signal.
Gain	It is the value of the amplification of the amplifier usually the the ratio of the output value divided over the input value,
Input Impedance	It is the input resistance of the amplifier.
Output Impedance	It is the output resistance of the amplifier.
Q-Point	The operating point of a device, also known as bias point or quiescent point (or simply Q-point), is the DC voltage and/or current which, when applied causes a circuit to operate in a certain desired function as an amplifier, normally used with certain connection of devices such as resistors.
AC coupling	AC coupling :In this case the output signal appears as AC without DC.
DC coupling	DC coupling : In this case the output signal appears as AC with DC
Filter	A circuit that is converting the AC signal to DC usually by using a capacitor with resistor.

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"The effect of virtual lab in acquiring engineering concepts, critical thinking skills and practical skills of the electronic engineering students at Yarmouk University"

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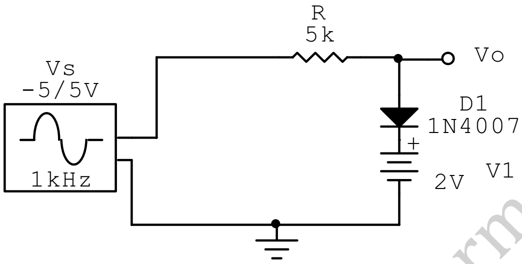
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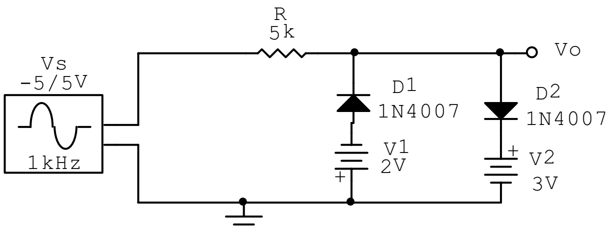
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. ƻ2.3+ Üƻ 1.3- Ƚŏk!Ăƺ!ƒ þljƵ ĭ ĂǁƵĂ Ŏǁƺʅ ƒ p (þ

: LJdž ýpǁ (Ƚdžp -Ƨƺ Ʈ)ýƤþdž!ƒ Ƚŏk!Ăƺ ǁžp ƘLjd ƚ ƒŖƒ ƒ p lƧƒƒþ LJĂƚk LJ! lƧƒƒþ!ƒ ljŖNj -5

. ƻ 2.3+ (Ɣ . ƻ 3.7+ (ǁ

. ƻ 1.3+ (þ . ƻ 2.7+ (Ɯ

: lƧƒƒþ Ĭ!ƒ lƧƒƒþ!ƒ ljŖNj ýĂơŏ ƻĂʅ ǁǁʅ V2 ȽŏƧƠƱ!ƒ ǁ!ƒþk ʅƒ LJǁ -6

ƻ 2.7- Ƚŏk!Ăƺ!ƒ þljƵ ýƺʅŰƒ Ƚnjŋ LJdž ƒ p (Ɣ . ƻ 2.7+ Ƚŏk!Ăƺ!ƒ þljƵ ĬǁƵŰƒ Ƚnjŋ LJdž ƒ p (ǁ

. ƻ 0.7- Ƚŏk!Ăƺ!ƒ þljƵ ýƺʅŰƒ Ƚnjŋ LJdž ƒ p (þ . ƻ ƧƺƮ Ƚŏk!Ăƺ!ƒ þljƵ ĬǁƵŰƒ Ƚnjŋ LJdž ƒ p (Ɯ

: lƧƒƒþ Ĭ!ƒ lƧƒƒþ!ƒ ljŖNj ýŏĂơk Ĭ!ƒ ĭ þƋŏ ƻĂʅ D2 þĂŏƒþ!ƒ ljƠŋkŬ ǁʅƚƵ þljƵ -7

ƻ 2.1- Ƚŏk!Ăƺ!ƒ þljƵ ýƺʅŰƒ Ƚnjŋ LJdž ƒ p (Ɣ . ƻ 2.7+ Ƚŏk!Ăƺ!ƒ þljƵ ĬǁƵŰƒ Ƚnjŋ LJdž ƒ p (ǁ

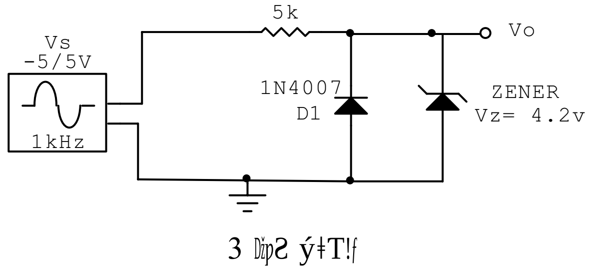
ƻ 2.3+ Ƚŏk!Ăƺ!ƒ þljƵ ĬǁƵŰƒ Ƚnjŋ LJdž ƒ p (þ ƻ 2.3- Ƚŏk!Ăƺ!ƒ þljƵ ýƺʅŰƒ Ƚnjŋ LJdž ƒ p (Ɯ

: ƘƒŖ lƧƒƒþ NkLjŏ ƻĂʅ D2 þĂŏƒþ!ƒĂ D1 þĂŏƒþ!ƒ ljƠŋkŬ ǁʅƚƵ þljƵ -8

.ýƤþdž!ƒ lƧƠTƒ ydž ƜƧƤdž!ƒ lƧƠTŬ ƫhƠƱk (Ɣ .íƧƺƮ ĭ ĂƠʅŏ ƜƧƤdž (ǁ

3.7+Ă 3.7- ƘƠŏk!Ăƺ!ƒ þljƵ Ŏǁƺʅ Ă ĭ Ăǁ Ƶ ƒ p (þ 2.3+Ă 1.3- ƘƠŏk!Ăƺ!ƒ þljƵ Ŏǁƺʅ Ă ĭ Ăǁ Ƶ ƒ p (Ɯ

:(10-9) ȽǁƑʅŰƒ LJƵ Ɣŋƒ ǁƛ 3 ǁpƧ ýƚT!ƒ Ŏƺ Ƚljŏhdž!ƒ lƧƒƒþ!ƒ ýŏƮĂh ǁp :3Σ



3 ǁpƧ ýƚT!ƒ

:lƧƒƒƥ lƧƒƒƥ!ƒ ǉǇǋ ýǄǆǉ -9

Ɨ) ƒ p ǉǆǅ Ɨǌη ǍǅǉŪƒ ƅ Ǧ ƂǌǏ Ǯ ƅƅ ƒ!Ă5!ƒ ƅǉǄǏ Ŀ (ƒ ƒ p ǉǆǅ Ɨǌη Ɨ ǏǉǄŪƒ ƅǉǄǏ Ŀ ƒ!Ă5!ƒ ǄǏ!ƀ -4.2 Ƨ .
+0.7 Ƨ .

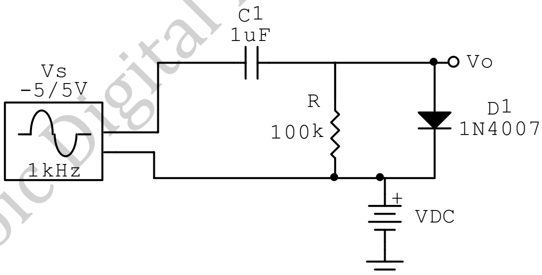
Ɨ) ƒ p ǉǆǅ Ɨǌη ǍǅǉŪƒ ƅǉǄǏ ƒ!Ă5!ƒ ǄǏ!ƀ (ƥ) ... ƒ p ǉǆǅ Ɨǌη ýǉǆŪƒ ƅǉǄǏ ƒ!Ă5!ƒ ǄǏ!ƀ -1.7 Ƨ .
+4.2 Ƨ.

-10 ǅǆ ƒ ưǅǉǅ ǅǅǅǅ ƗǈƧǈǅ ƗǉǅƗ ǅ +1 Ƨ ǍǅǉŽ ƒ!ǅǅƒ!Ŏ ǅǉy Ţ ǅǅǅǅ ƒ!ƨǅǈƧ ǉǅ Ă Ƨ ǅǉǆǈ :

(ǅ ƥƒƒƧl p ƒ ǉǆǅ Ɨǌη ǍǅǉŪƒ ƅǉǄǏ ƒ!Ă5!ƒ ǄǏ!ƀ +4.2 .   (Ɣ ƥƒƒƧl p ƒ ǉǆǅ Ɨǌη ǍǅǉŪƒ ƅǉǄǏ ƒ!Ă5!ƒ ǄǏ!ƀ +3.2.

(Ш ƥƒƒƧl p ƒ ǉǆǅ Ɨǌη ǍǅǉŪƒ ƅǉǄǏ ƒ!Ă5!ƒ ǄǏ!ƀ +5.2 .   (ƥ ǅƥǅ ĂηĂƥ p ƒ ǉǆǅ Ɨǌη ǍǅǉŪƒ ǅǉǅǅǅ.

ƒ!ηƨƇ :(2) ƥĂƒƒƧ ƒ!ǉǅǉƨ.
Σ4: ǅǅ ǅǅǅǅ ǅƮǆý ƒ!ƥƒƒƧl ǅǅǅǅǅƗ Ŏ5 ƒ!T‡ý ƧǅǅǅǅǅǍ 4 ǅǅǅ ƒηƔ ǉǅ ǅŪǆǅƗ (11-16):



4 ǅǅƧ ƒ!T‡ý

-11 ǅǉǄ ƤǉǅƧ‖ !ǍǉǅƗ ƒ!Ă5!ƒ ƒ!ǅǅǅƗ !ǅǅǉĂĭ ƮƧƭǂ ǅĂǅ ǅǅǅǅ ƥƒƒƧl:

(Ɣ ƥƒƒƧl p ƒ ǉǆǅ Ɨǌη ǍǅǉŪƒ ƅǉǄǏ ƒ!Ă5!ƒ ǄǏ!ƀ +4.2 Ƨ .   (Ɣ ƥƒƒƧl p ƒ ǉǆǅ Ɨǌη ǍǅǉŪƒ ƅǉǄǏ ƒ!Ă5!ƒ ǄǏ!ƀ +3.2 Ƨ .

(Ш ƨǅǅǅ !Ɨǌη ǍǅǉŪƒ ƅǉǄǏ ƒ!Ă5!ƒ ƒ!ǅǅǅƗ +4.3 Ƨ.   (ƥ ƨǅǅǅ !Ɨǌη ýǉǆŪƒ ƅǉǄǏ ƒ!Ă5!ƒ ƒ!ǅǅǅƗ -4.3 Ƨ.

-12 ǅǉǄ ƤǉǅƧ‖ !ǍǉǅƗ ƒ!Ă5!ƒ ƒ!ǅǅǅƗ !ǅǅǉĂĭ ƮƧƭǂ ǅĂǅ ǅǅ‡ĂǅL ǅǅǅǅ ƮƤƧШ ƒ!ƥƒƒƧl (ƮƧƨ- ǅǅǅ) ǅǉǅĂĭ:

(ǅ +9.7 Ƨ .   (Ɣ +9.3 Ƨ .

(Ш +5.7 Ƨ .   (ƥ +0.7 Ƨ .

:ǋǩǉŏ ƻĂƪ ƻ 1+ ĭĂƓƪķ! ƚķhƓλ!ƒ Ɨŏķ!Ăƺ!ƒ Ɨďžŏp ǀþƓŏƨ ǇƉ -13

. ƻ Ƨƺƫ ĭĂƓƪŏ ǀƧƒþǁ! ǘηƧƤďž (ǁ

. ƻ 1.7- Ɨŏķ!Ăƺ!ƒ þǉƵ ýƺƪǕƒ Ɨnjη ǇǇďž ƒ p ǀƧƒþ (ƔY

. ƻ 3.3- ƗķhƓλ!ƒ Ɨŏķ!Ăƺ!ƒ þǉƵ ýƺƪǕƒ Ɨnjη! ƽŏǁƶķ ǀƧƒþ (Ш

. ƻ 3.3+ ƗķhƓλ!ƒ Ɨŏķ!Ăƺ!ƒ þǉƵ ĬǁƵǕƒ Ɨnjη! ƽŏǁƶķ ǀƧƒþ (þ

Ɨďžŏp ĬǁƵƒ ǊǁƓηƧƤďž ǋǩǉŏ ƻĂƪ þĂŏƒþ!ƒ ǉƓηķƒ Σ ǂƵ ydž ƻ 2+ ĭĂƓƪķ! ƚķhƓλ!ƒ Ɨŏķ!Ăƺ!ƒ Ɨďžŏl! ǁķþƓŏƨ þǉƵ -14
:ĭĂƓƪķ (Ɨďžp -Ƨƺƫ) Ɨŏķ!Ăƺ

. ƻ 6.3+ (ƔY
. ƻ 4.3+ (ǁ

. ƻ 11.3+ (þ
. ƻ 0.7+ (Ш

ǀƧƓƬƒ ĬǁƵ ƗƺƓưďž ƗķhƓλ Ɨŏķ!Ăƺ ĬǁƵ ǀƧƒþ!ƒ ǉȐnj! ШƧƤďž!ƒ ǀƧƓƬƒ ĭĂķơķ ƻĂƪ Ü ǉűƵƒ 14 ýƒƋƪ Ŏƺ -15
: ĭĂƓƪķ ýƤþďž!ƒ

. ƻ 6.3+ (ƔY
. ƻ 4.3+ (ǁ

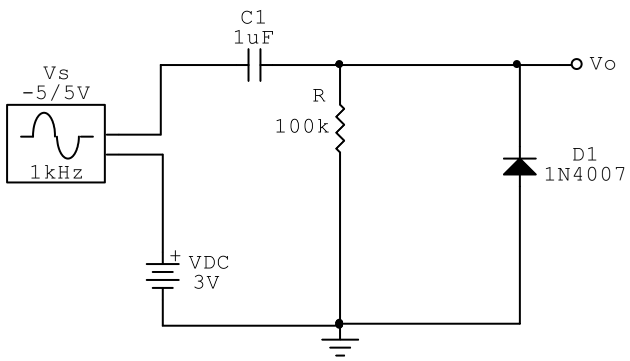
. ƻ 1.3+ (þ
. ƻ 0.7+ (Ш

: ШƧƤďž!ƒ ǀƧƓƬƒ ýƶηŏ ƻĂƪ ǁ!Ʀ ǇƋƺ ǊǆĂƒ100 Ĭ!ƒ ǊǆĂƒ Ăǁŏǂ100 ǇǇďž ƗďžĂƓǀďž!ƒ Ɨďžŏl! ǁƧŏǒķ þǉƵ -16

. ƒ pƓǉķķ (ƔY
.þƒþƨķ (ǁ

.ǋŏĂƬķ Ɠnj! ýƫơŏ (þ
.ŎǋǇ Ɠdžǂ Ĭǀhķ (Ш

:(20-17) ƗǁƑƪǕƒ ǇƵ ƔYηƒ ǊǆĂ 5 ǊǆpƧ ýǂƬ!ƒ Ŏƺ ƗǉŏhďžƒǀƧƒþ!ƒ ýŏƫĂķh Ǌǆp :5Σ



5 ǊǆpƧ ýǂƬ!ƒ

:lƧƑƒƥ lƧƑƒƥ!ƒ ǉƦǋ ýƛdžǩ -17

.ĬǁƵŰƒ Ɨnjŋ LJdž ƒ p (Ɖ .ý5ƪŰƒ Ɨnjŋ LJdž ƒ p (Ɣ

. ĬǁƵŰƒ Ɨnjŋ! ʦŏǁƶǩ (Ш .ý5ƪŰƒ Ɨnjŋ! ʦŏǁƶǩ (ƥ

:ƻĂƪ (Ɨdžp -Ƨ5Ʈ) ШƧƤdžǁ! ƗŏǩĂ5 Ɨdžŏp ĬǁƵƒ LJƉ -18

.ƻ 7.3 Ĭ!ƒ ƥƒƥƨǩ (Ɖ .ƻ 12.3 Ĭ!ƒ ƥƒƥƨǩ (Ɣ

.ƻ 3.0 Ĭ!ƒ ƒ pǴǉǩǩ (Ш .ƻ 4.3 Ĭ!ƒ ƒ pǴǉǩǩ (ƥ

:ĭĂǴƪǩ (Ɨdžp -Ƨ5Ʈ) ШƧƤdžǁ! ƗŏǩĂ5 Ɨdžŏp ýpƉ LJǫ -19

. ƻ 2.3+ (Ɖ . ƻ 0.7- (Ɣ

. ƻ 2.3- (Ш . ƻ 0.7+ (ƥ

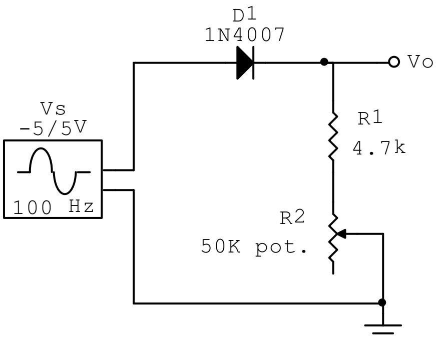
:ĭĂǴƪǩ ýƤƥdž!ƒ lƧǴƬƒ ĬǁƵ Ɨ5Ǵưdž ƗǩƀǴƛ ƗŏǩĂ5 ĬǁƵ lƧƑƒƥ!ƒ ǉƦǌ! ШƧƤdž!ƒ lƧǴƬƒ ĭĂǩơǩ ƻĂƪ -20

. ƻ 7.3+ (Ɖ . ƻ 3.0+ (Ɣ

. ƻ 4.3+ (Ш . ƻ 12.3+ (ƥ

.ƉŏĂlǩ!ƒ ƧƑƒĂƥ :(3) Ǵƨŋ!ƒ

:(25-21) ƗǁƑƪŰƒ LJƵ Ɣŋƒ Ɖƛ 6 ƉpƧ ýǂƬ!ƒ Ŏ5 ƗǉŏhƉdž!ƒ lƧƑƒƥ!ƒ ýŏƮĂǩƀ Ɖp :6Σ



6 ƉpƧ ýǂƬ!ƒ

: lƧƑƒƥ lƧƑƒƥ!ƒ ǉƦǋ ýƛdžǩ -21

. ĬǁƵŰƒ Ɨnjŋ! ʦŏǁƶǩ (Ɖ .ý5ƪŰƒ Ɨnjŋ! ʦŏǁƶǩ (Ɣ

.ƗŋĂdž!ƒ ƻ Ʈǉ ƉŏĂlǩ (Ш . ƻ Ƨ5Ʈ ƥǉƵ ĬǁƵŰƒ Ɨnjŋ LJdž ƒ p (ƥ

.ýPþdž!f lƧĠTf ŧħŖħŖ ŧdžöp .... ĭĂĠʅk ƨĂʅ lƧſfþ!f ǉŖǌ! ɯƧPdž!f lƧĠTŬ ŧħŖħŖ!f ŧdžöp ǁʅĠöp ǇǊ -22

.ŕdžĠdžk (Ɣ . ƨ Ʈǉ (ƉƉ

ƨĠƶ ư ƉŧȜŭȜ (þ .Ŏ5ƶ ư (ɯ

ƨĂʅ ɯƧPdž!f lƧĠTf ý‡T ǇǊ5 ƯƧŬfĂ ɯƧPdž!f ǇǊöħ (þfƧĠ5ĂƧ‡ödž 4.7) ŧdžölħ ƨȜ‡dž ǁöƮĂk þǉƵ -23
....Ĭ!fƧöʒkö

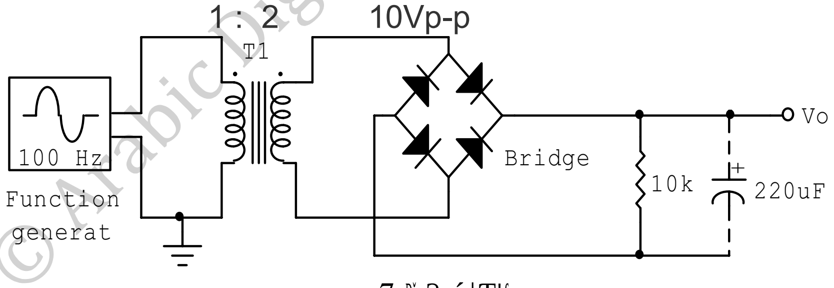
ĠnjǉǊ5 (þfƧĠ5ĂƧ‡ödž 4.7 ŧdžölħ ƨȜ‡dž!f þĂŋĂħ) ɯĂdžk! ŧöĂfdž!f ŧħʅǉ!f ŧdžöl! ǁʅĠöp þǉƵ -24
......................................ĭĂĠʅk

: ƨĂʅ ɯĂdžk!f ŧħʅǉ ǇǊ5 DžĂfĂöŧ 10.0 Ĭ!f DžĂfĂöŧ 1.0 Ǉdž lƧöʒkdž!f ŧdžĂĠldž!f ŧdžöl! ǁƧööʒk þǉƵ -25

.%10 ŧħʅǉħ Ĭ!f ƒ pĠǉkk (Ɣ .%10 ŧħʅǉħ þfþƨk (Ɖ

.%0.01 ŧħʅǉħ Ĭ!f ƒ pĠǉkk (þ .%0.011 ŧħʅǉħ þfþƨk (ɯ

:(30-26) ŧǉfʅŬf ǇƵ Ɣŋf DžȜ (2:1 ýĂơdž!f ƘĠ5! þþƶħ) 7 DžpƧ ý‡T!f Ŏ5 ŧǉöħdž!f lƧſfþ!f ýöƮĂkħ Džp :7Σ



7 DžpƧ ý‡T!f

: lƧſfþ lƧſfþ!f ǉŖǌ ýȜdžk -26

.Ǌ5Ʈkǉdž ƯƧɑdž ýĂơdž ƘfŖ ǊŋĂdž!f ýdžĠ‡ DžöĂlk (Ɣ . ý5ʅŰfĂ ĬǉƵŪf ŧnjŋ Ǉdž ƒ p ĂŖ ýĂơdž (Ɖ

ǊŋĂdž!f ýdžĠ‡ DžöĂlk (þ .ŧŋĂdž!f ƨ Ʈǉ DžöĂlk (ɯ

......................................ĭĂĠʅk ƨĂʅ lƧſfþ!f ǉŖǌ! ŧkħĠȜ!f ŧök!Ă5!f ŧdžöl! ǁʅĠöp þǉƵ -27

.......................ĭĂĠʅk ƨĂʅ ýPþdž!f lƧĠTŬ (ŧdžp -Ƨ5Ʈ) ŧök!Ă5ǉ! ŧdžl!f ŧdžöl! ǁʅĠöp þǉƵ -28

: ĭĂǴƪƙ ƧĂƪ ƖƨƒƥƁ ǉƦǌ! ƜƨƤǆ!ƒ ƖƨǴƬǓ ƗƞƦƞƦ!ƒ Ɨǆǒƚ! ǁƪǴƪƿ ǇǇ -29

. ƨƙƨǒǋ 50 (ǃ

.ƨƙƨǒǋ 100 (Ƴ

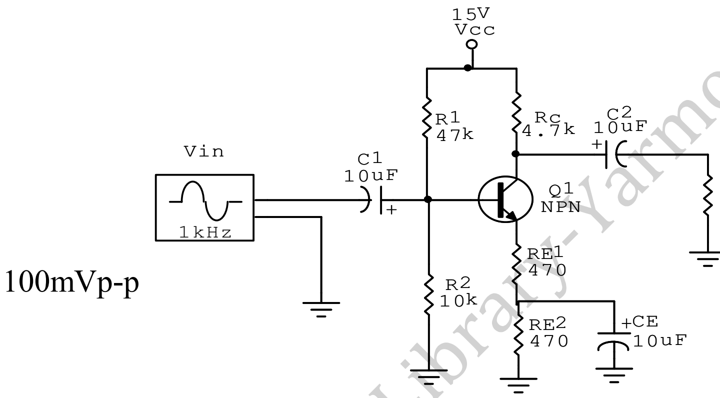
.ƨƙƨǒǋ 200 (Ɯ

.ƨƙƨǒǋ 400 (ƥ

ĭĂǴƪƙ ƧĂƪ ǴǌǇǄ ƜĂǆǅǉ! ƗǒĂƑǆ!ƒ ƗƞƪǇ!ƒ Ɨǆǒƚ! ǁƪǴǒƿ ƥǇƵ -30..................................

. (ƨǒƞǂƙ!ƒ) ǅǒƤ ư ƙ!ƒ ƨƒĂƥ :(4) Ƈƨƞ!ƒ

:(40-31) ƗǇƑƪǕƒ ǇƵ Ƴƞƒ ǅǈ 8 ǅƿƨ ǿǂƬ!ƒ Ŏ5 ƗǇǒƞǆ!ƒ ƖƨƒƥƁ!ƒ ǿǒƮĂƙƞ ǅƿ :8Σ



8 ǅƿƨ ǿǂƬ!ƒ

: ƖƨƒƥƁ ƖƨƒƥƁ!ƒ ǉƦǋ ǿǅǆƙ -31

. ƖƥƵǴƚ!ƒ Ư ƨƊǆ ǅǒƤ ư ƙ (ǃ

.ǿǆǴƞ!ƒ Ư ƨƊǆ ǅǒƤ ư ƙ (Ƴ

. ƗƵǴǅ!ƒ Ư ƨƊǆ ǅǒƤ ư ƙ (Ɯ

.ƨƥƮǆ!ƒ Ư ƨƊǆ ǅǒƤ ư ƙ (ƥ

ĭĂǴƪƙ ǴǌǇǄ ƨĂƙƪǒƨǇǅƨƙǅ! ǿǒƺƬƙ!ƒ ƗƱǇǇ! ƗƙǅǴƛ!ƒ Ɨǒƙ!ĂƧ!ƒ Ɨǆǒƚ! ǁƪǴǒƿ ƥǇƵ -32...........................

ĭĂǴƪǒ ǋǇǄ ƨĂƙƪǒƨǇǅƨƙǅ! ǿǆǴƞǅ! ƘƙǅǴƛ!ƒ ƨǴǒƙ!ƒ Ɨǆǒƚ! ǁƪǴǒƿ ƥǇƵ -33.......................................

ĭĂǴƪƙ ǴǌǇǄ ƖƨƒƥƁ!ƒ ǉƦǌ! ǅǒƤ ư ƙ!ƒ Ɨǆǒƚ! ǁƪǴǒƿ ƥǇƵ -34..

ĭĂǴƪƙ ǴǌǇǄ ƖƨƒƥƁ!ƒ ǉƦǌ! ƗǒǇƤƒƥ!ƒ ƗǆĂǴǈǆ!ƒ Ɨǆǒƚ! ǁƪǴǒƿ ƥǇƵ -35..

ĭĂǴƪƙ ǴǌǇǄ ƖƨƒƥƁ!ƒ ǉƦǌ! ƗǒƞƨǴƤ!ƒ ƗǆĂǴǈǆ!ƒ Ɨǆǒƚ! ǁƪǴǒƿ ƥǇƵ -36..

-37 [illegible] ....

-38 [illegible] .... [illegible] .

-39 [illegible] ...... [illegible].

-40 [illegible] ..... [illegible] .

(8) ѕσǐǚ

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Acquiring electronic engineering concepts exam

Part (1): Clipper circuits.

Q.1) Connect the circuit shown in Figurre.1. Then answer the questions (1-3)

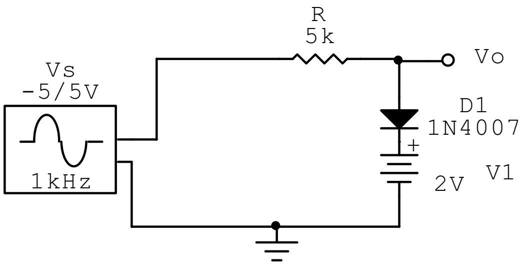


Figure.1

1- This circuit represents:

a) Positive Clipper. b) Negative Clipper.

b) Positive Clamper. d) Negative Clamper.

2- The output of the circuit can be described as:

a) Clipping at 0.7V. b) Clipping at 2.7V.

c) Clamper with 2.7V DC. d) Clamper with 1.3V DC.

3- IF we Decrease the input voltage to 4Vp-p, this will result in:

a) No output

b) A distortion in the output shape.

c) The output is clipping at 1.3V.

d) The output is the same as the input.

Q.2) Connect the circuit shown in Figurre.2 then answer the questions (4-8)

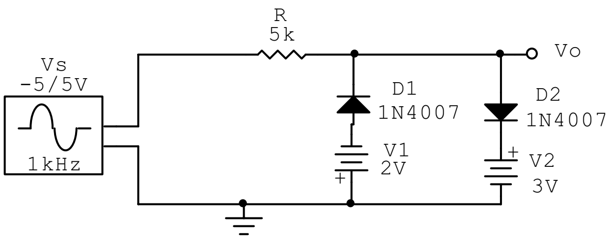


Figure.2

4-This circuit represents:

a) A positive and negative clipper at +2.7V,-3.7V

b) A negative and positive clipper at -2.7V,+3.7V

c) A positive and negative clipper at +1.3V,-2.3V

d) A negative and positive clipper at -1.3V,+2.3V

5-This circuit will have no clipping if the input (0-P) is Less than:

a) +3.7V. b) +2.3V.

c) +2.7V. d) +1.3V.

6- Replacing the battery V2 with short circuit will result in:

a) A positive clipper at +2.7V

b) A negative clipper at -2.7V

c) A positive clipper at 0V.

d) A negative clipper at -0.7V

7- Reverse the diode D2 in opposite the direction will have:

a) A positive clipper at +2.7V

b) A positive clipper at -2.1V.

c) A negative clipper at -2.3V

d) A negative clipper at +2.3 V

8- Reverse the direction of diodesD1 and D2 will result in:

a) No output.

b) The output is the same as the input.

c) Clipping at -1.3V and +2.3V

d) Clipping at -3.7V and +3.7V

Q.3) Connect the circuit shown in Figurre.3 then answer the questions (9-10):

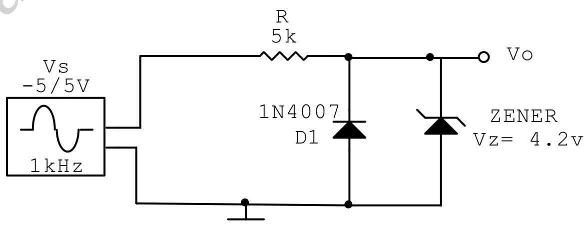


Figure.3

9- This circuit has:

a) A negative clipping at -4.2V

b) A positive clipper at +0.7V.

c) A negative clipping at -1.7V.

d) A positive clipper at +4.2V.

10-Adding a battery of +1.0V in series with the zener diode will result in:

a) A positive clipping at +4.2V

b) A positive clipping at +3.2V

c) A positive clipping at +5.2V.

d) No positive clipping.

Part (2): Clamper circuits.

Q.4) Connect the circuit shown in Figurre.4 then answer the questions (11-16):

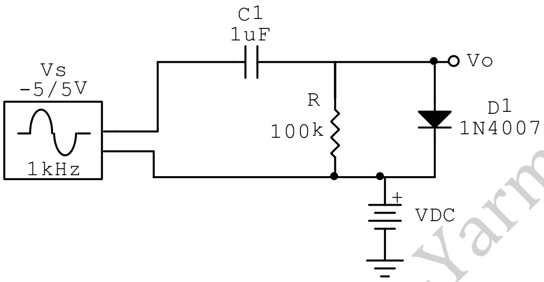


Figure.4

11- With V_{DC}= 0V; this circuit is:

a) A positive clipping at +0.7V

b) A negative clipping at -0.7V.

c) A positive clamping with DC= +4.3V.

d) A negative clamping with DC= -4.3V.

12- With V_{DC}= 0V; the maximum peak of the output is:

a) +9.7V b) +9.3V.

c)+0.7V d) +5.7V.

13- Increasing the V_{DC} to 1.0V will make the output:

a) Equal to zero.

b) Negative clipping at -1.7V.

c) A negative clamping with DC= -3.3V.

d) A positive clamping with DC= +3.3V.

14- If we Increase the V_{DC} to 2.0V and reverse the diode in the opposite direction, then the maximum peak of the output is:

a) +4.3V b) +6.3V.

b) +0.7V d) +11.3V.

15- For question 14, the DC value (DC Shift) for this state is:

a) +4.3V b) +6.3V.

c) +0.7V d) +1.3V.

16- Changing the resistor R from 100KΩ to 100Ω will make the output:

a) Increases b) Decreases.

c) Still the same d) Distorted.

Q.5) Connect the circuit shown in Figurre.5 then answer the questions (17-20):

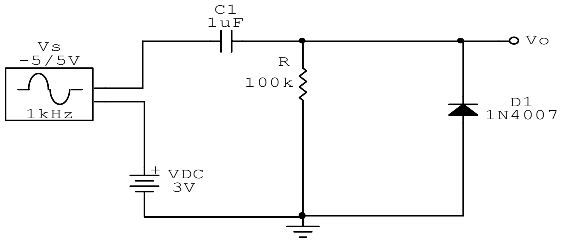


Figure.5

17- This circuit is:

a) A positive clipper.

b) A negative clipper.

c) A positive clamping.

d) A negative clamping.

18- The maximum output peak of this circuit:

a) Increases to 7.3V b) Increases to 12.3V

c) Decreases to 3.0V d) Decreases to 4.3V

19- And the minimum output peak of this circuit:

a) +2.3V b) -0.7V.

c) -2.3V d) +0.7V.

20- And the DC value of this circuit will be:

a) +7.3V b) +3.0V.

c) +4.3V d) +12.3V.

Part (3): Rectifiers circuits.

Q.6) Connect the circuit shown in Figurre.6 then answer the questions (21-25):

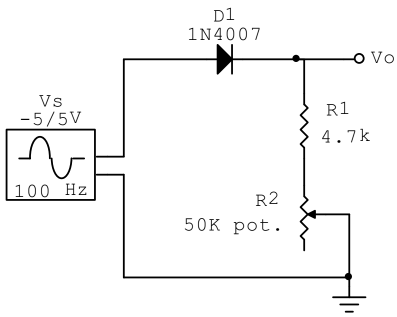


Figure.6

21- This circuit represents:

a) A positive clamper.

b) A negative clamper.

c) A half wave rectifier.

d) A positive clipper at 0V.

22- The output frequency for this circuit is Ľ Ľ Ľ Ľ Ľ Ľ Ľ Ľ the input frequency.

a) Half of.

b) The same as.

c) Twice of.

d) Triple of.

23- Connecting 4.7·F capacitor between Vo and the ground will change the Output to Ľ Ľ Ľ Ľ Ľ Ľ Ľ Ľ .signal.

24- Measuring the %ripple (when 4.7·F capacitor) of this circuit is equal to Ľ Ľ Ľ Ľ Ľ Ľ

25- Increasing the Rpot. from 1KΩ to 10KΩ will:

a) Decrease the ripple by 10%.

b) Increase the ripple by 10%.

c) Decrease the ripple by 0.01%.

d) Increase the ripple by 0.01%.

Q.7) After connecting the circuit shown in Figurre.7 with (1:2) transformer, answer the questions (26-30):

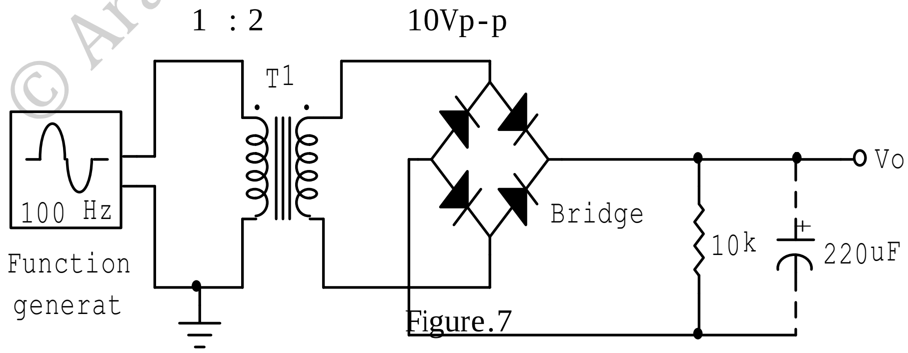


Figure.7

26- This circuit represents:

a) A positive and negative clipper transformer circuit.

b) A center tapped full wave rectifier circuit.

c) A half wave rectifier circuit.

d) A full wave rectifier circuit.

27- The Value for the output DC voltage is equal Ľ Ľ Ľ Ľ Ľ Ľ Ľ ..

28- The Input zero-peak voltage is……………………………

29- The output frequency for this circuit is equal:

a) 50Hz. b) 150Hz c) 200Hz d) 300Hz

30- Measuring the %ripple of this circuit is equal to ……………

Part (4): Amplifiers circuits.

Q.8) Connect the circuit shown in Figurre.8 then answer the questions (31-40):

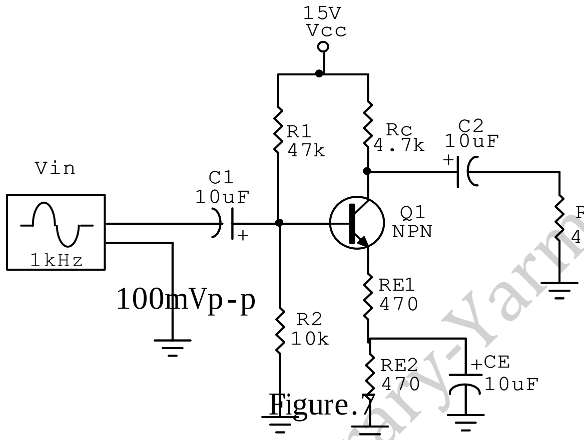


Figure.7

31- This circuit represents:

a) A common base amplifier.

b) A common collector amplifier.

c) A common emitter amplifier.

d) A common source amplifier.

32- Measuring the DC Q-point base voltage V_{BQ} is equal to……………

33- Measuring the collector current I_{CQ} is equal to………………..

34- Measuring the voltage gain of this circuit is equal to …………….

35- Measuring the input resistance of this circuit is equal to ………..

36- Measuring the output resistance of this circuit is equal to ………

37- Measuring the Beta (β) of this circuit is equal to ………

38- Remove the Bypass capacitor of this circuit will ……………. the voltage gain.

39- Replace the Bypass capacitor and remove the load resistor R_L, then the voltage gain of this circuit will ……………..

40- Remove R_{E1} will …………………..the value of the gain.

a) Decrease.

b) Increase.

c) Have no effect on.

d) Duple.

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"**The effect of virtual lab in acquiring engineering concepts, critical thinking skills and practical skills of the electronic engineering students at Yarmouk University**"

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3				X		23	DC			
4		X				24	1.23%			
5	X					25	X			
6		X				26				X
7				X		27	3.18V			
8			X			28	2.5			
9				X		29			X	
10				X		30	0.066%			
11				X		31			X	
12			X			32	2.63V			
13			X			33	2mA			
14				X		34	8.72			
15		X				35	6.5 KΩ			
16				X		36	4.3KΩ			
17			X			37	~ (70-100)			
18		X				38	Decrease			
19	X					39	Increase			
20	X					40		X		

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"**The effect of virtual lab in acquiring engineering concepts, critical thinking skills and practical skills of the electronic engineering students at Yarmouk University**"

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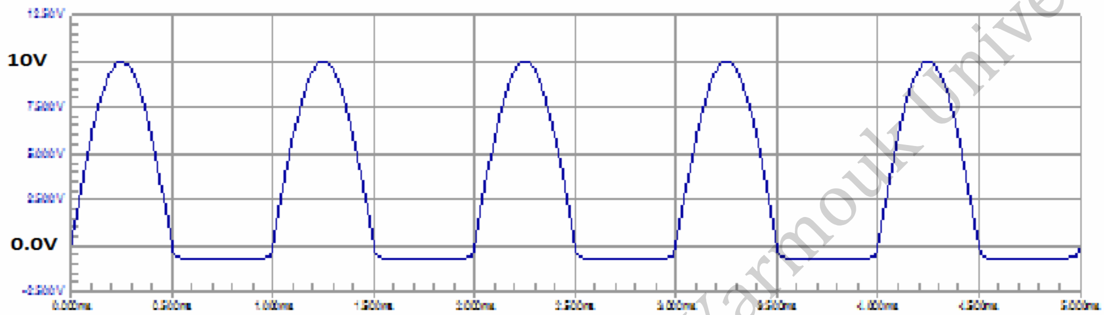
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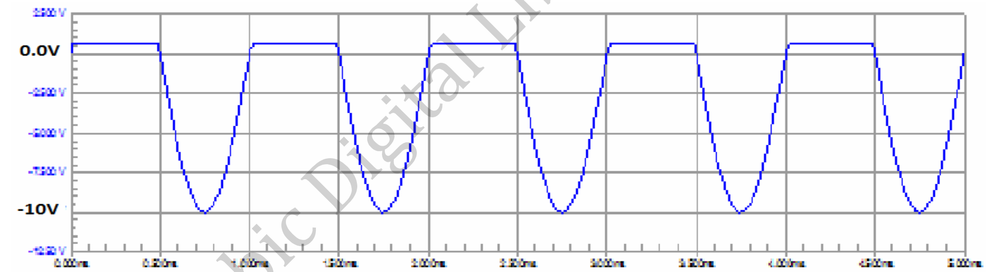
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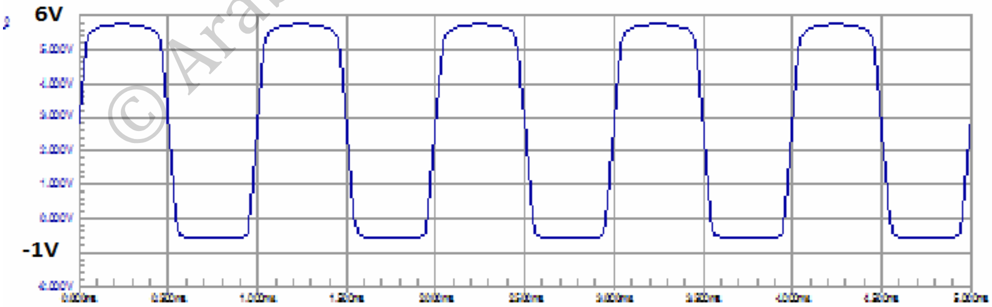
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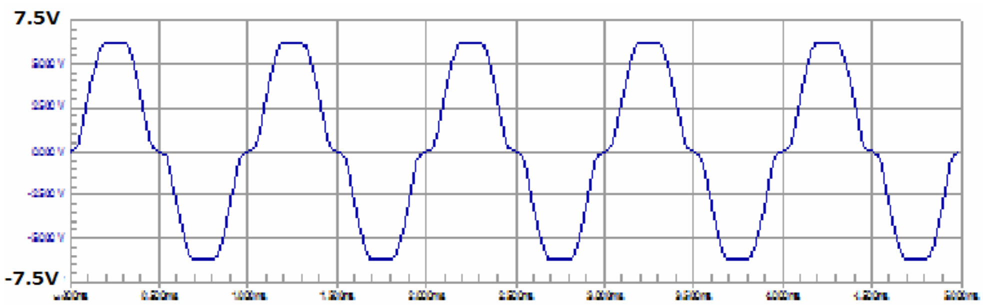
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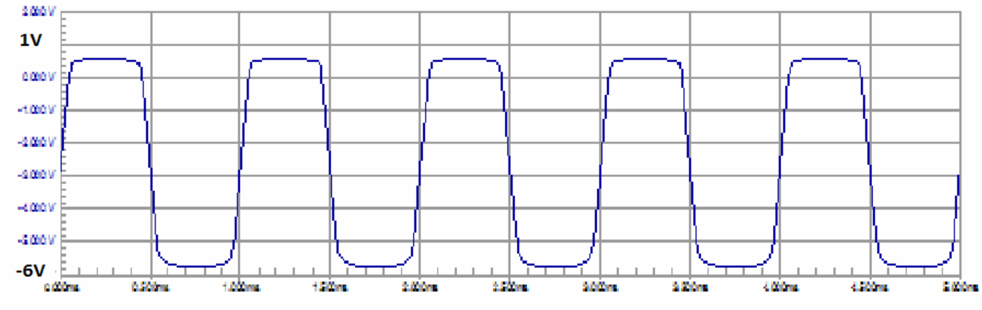
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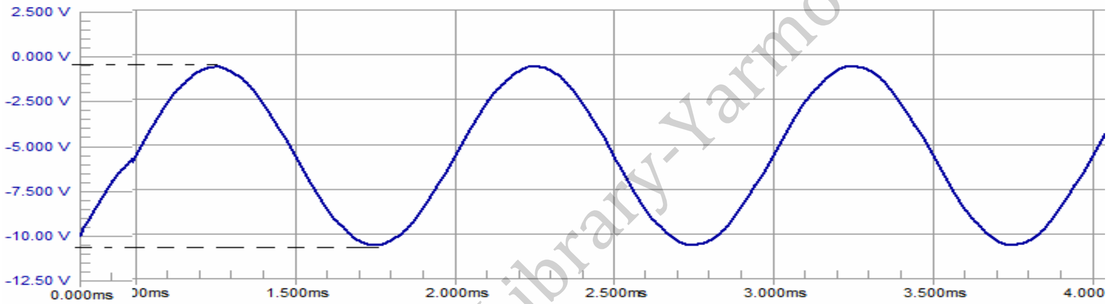
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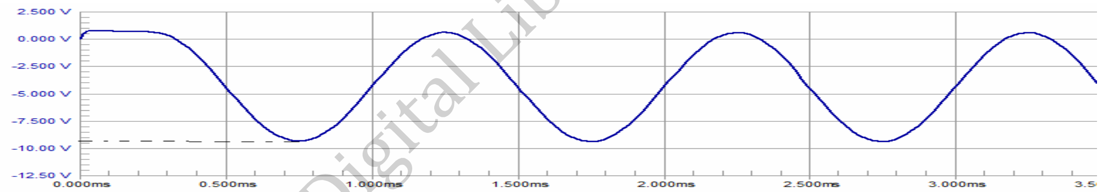
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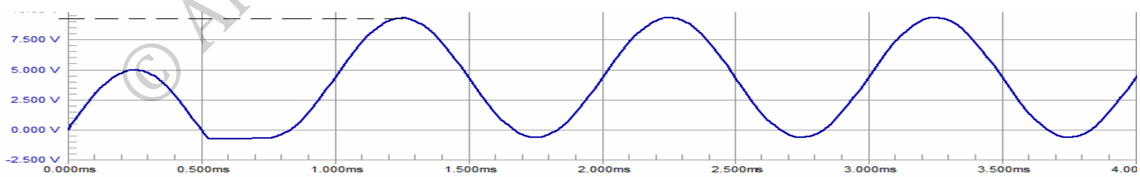
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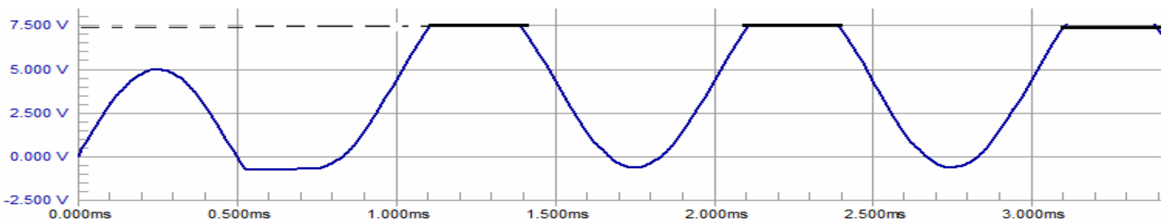
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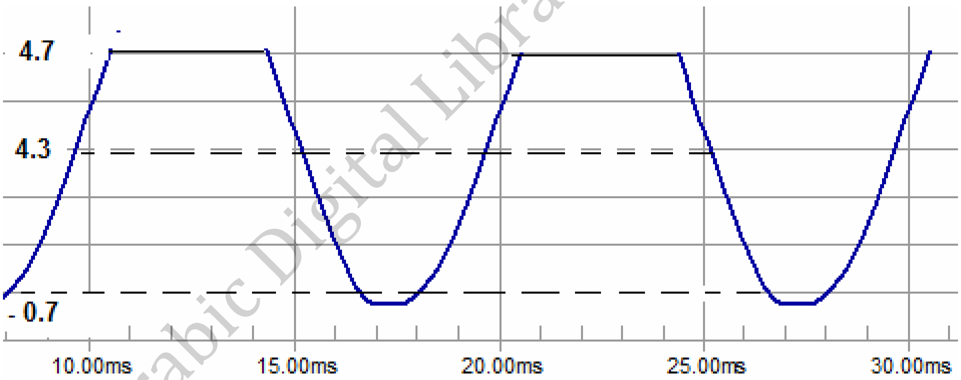
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Critical thinking skills exam
(Part 1): Predicting of assumptions

Q 1): If a student has connected an electronic circuit and got an output signal shape as shown in Figure.1 below;

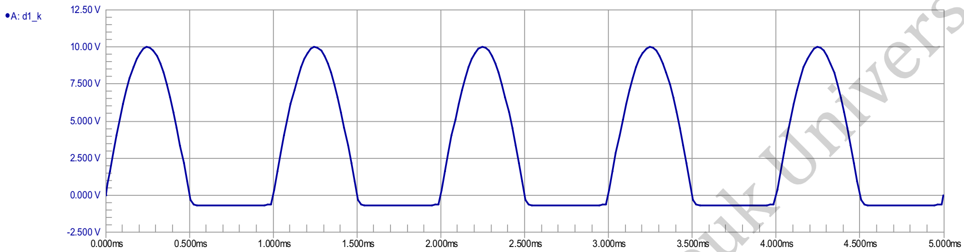
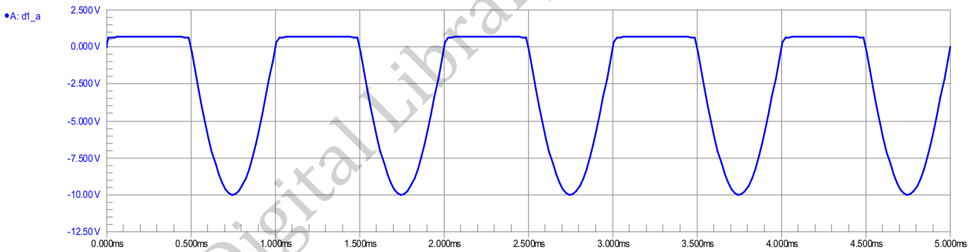


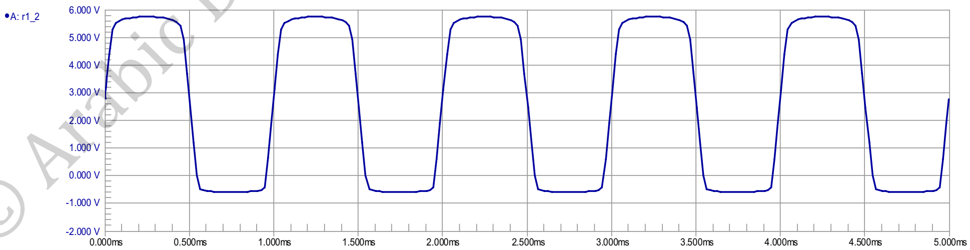
Figure.1

The output signal – when he is replacing the silicon diode with zener diode in the same direction - will be as in the following shape:

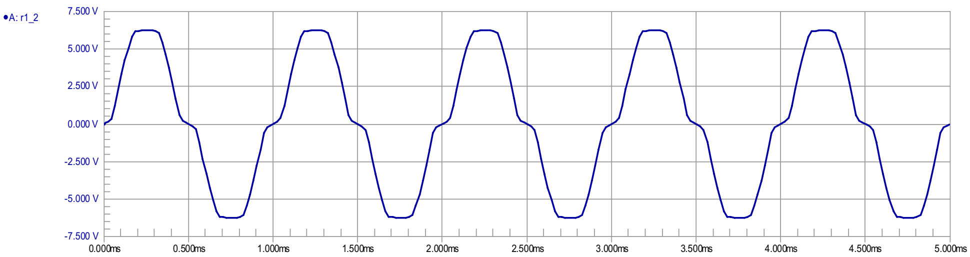
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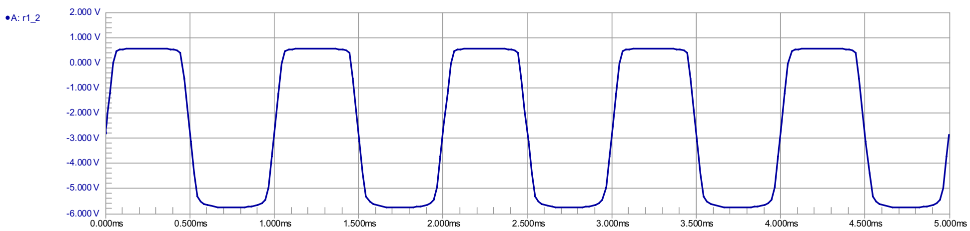
B)



C)



D)



Q 2): The instructor has connected a positive clamping circuit that has a fixed DC voltage of 4.3 V and an input signal of 10.0V p-p. and then he modified this circuit so it produced the output signal as shown in Figure.2;

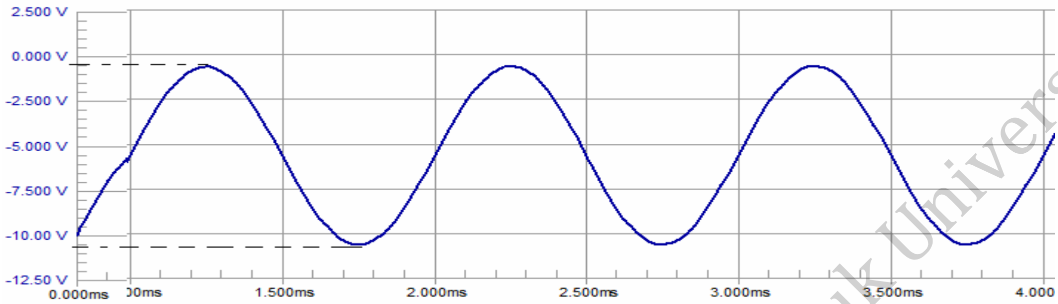


Figure. 2

So, practically the instructor was do the following:

A) Disconnect the existing battery in the circuit.

B) Add a positive battery for the circuit.

C) Add a negative battery for the circuit.

D) Reverse the direction of the diode

Q 3) Noor connected a full wave rectifier circuit with a capacitor and a load resistor at the output, then later, she replaced this capacitor with another one of higher capacitance; this circuit will change to give a:

A) Half-wave rectifier.

B) Smaller % ripple..

C) Higher % ripple.

D) DC voltage with a small percentage value

Q 4) A student has a common emitter amplifier circuit, and then he disconnect the capacitor between the collector and the load resistor, the output signal will be:

A) Less than the previous one.

B) Greater than the previous one.

C) With no any change from the previous one.

D) More distorted than the previous one

Part (2): Explaining

Q 5): Ali was connected a clamping circuit which gave the result as shown in Figure.3 Then his friend Khalid made some changes on this circuit so he get two different signals as shown in Figure 4 and Figure 5, respectively, Ali has explained that Khalid first was do the following:

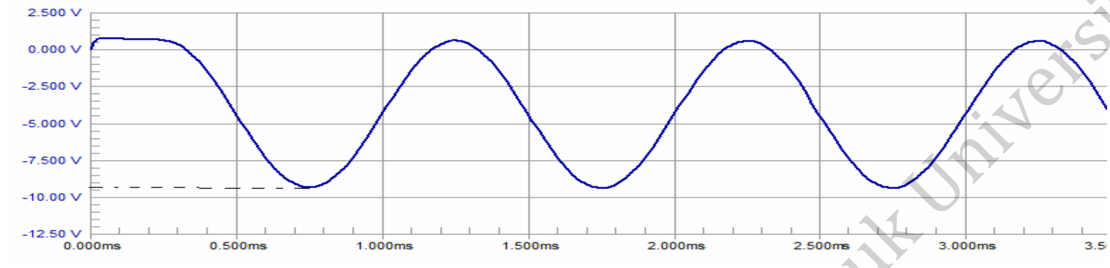


Figure.3

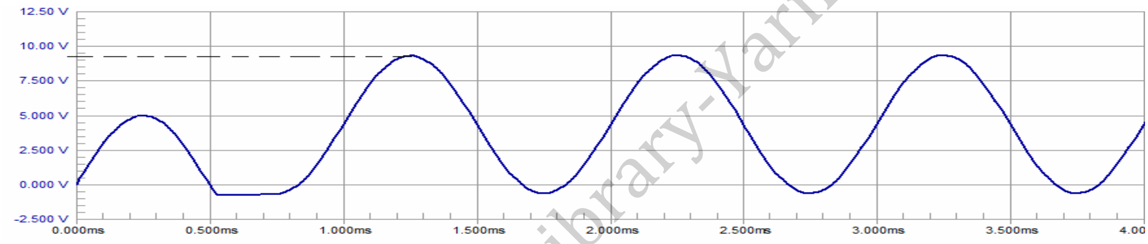


Figure.4

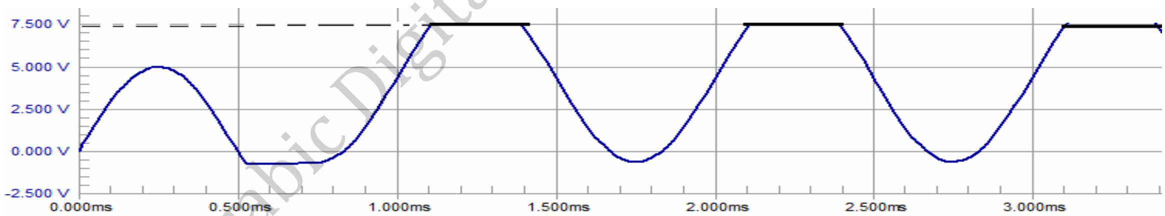


Figure.5

A) Add a positive DC battery equal +5.0V for the circuit.

B) Add a positive DC battery equal + 9.3V for the circuit.

C). Reverse the direction of the diode towards the top.

D) Reverse the direction of the diode towards the bottom

Q6): And secondary, Ali explained that Khalid modified the circuit by adding new pieces to the output like:

A) A battery and a diode which there directions towards the bottom. .

B) A diode with its direction towards the top.

C) Two back to back batteries between the output and ground.

D) A zener diode with its direction towards the top

Q 7): After a student was connected a full wave bridge rectifier circuit he faced a failed trouble so this circuit produces a half wave rectifier output signal, the student explained that this is due to a fault in:

A) The transformer that was used in this circuit. .

B) One of the diodes which are used in the bridge.

C) Two or more diodes which are used in the bridge.

D)The capacitor that was connected between the output and the ground

Q 8: A student was surprised when he connected a common emitter amplifier that this circuit produced a small amplification value, this is can be explained that the student may:

A) Use a very low value load resistance.

B) Remove the bypass capacitor.

C) Not connect the Vcc voltage to the circuit.

D) A + B

Part (3): Conclusion

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Q 9): The instructor asked the student to connect a positive clamping circuit using a Zener diode, but he noted that the output signal was perfectly matched the input signal, this is can be explained that:

A) The student may use the silicon diode instead of a Zenerr diode.

B) The value of the input signal frequency is very high and does not fit with the

circuit used.

C) The value of the input signal voltage is less than the value of the clipping voltage.

D) The value of the input signal voltage is greater than the value of the clipping voltage

Q 10): When a student connected a circuit, he got an output signal as shown in Figure. 6, this is can be explained that the student has connected a circuit of:

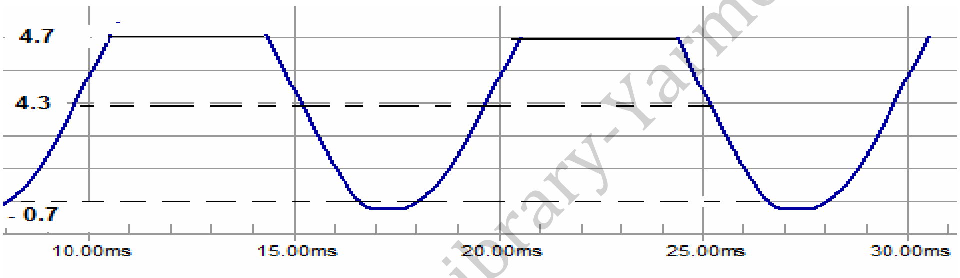


Figure.6

A) A negative clipper at -0.7V

B) A positive clipper at +4.7 V.

C) A negative and positive clipper at -0.7V and+4.7 V.

D) at positive clamping With DC voltage of +4.3V followed by a positive clipper at +4.7 V

Q 11): Through your studying of half wave and full wave a bridge rectifier circuits you can conclude that one of the following sentences is right:

A) The half eave rectifier circuits can be used without a transformer.

B) The full wave a bridge rectifier circuits can be used without a transformer.

C) The % ripple value in the full wave a bridge rectifier is less than the % ripple value in the half eave rectifier circuits

D) A+C

Q 12): Also through your studying of the amplification circuits you can conclude that the best voltage amplifier circuit is the:

A) Common base amplifier.

E) Common collector amplifier.

F) Common emitter amplifier.

G) Common source amplifier.

Part (4): Analysis

Q 13: A common emitter amplifier was connected to get an amplification value equal equal to (10) , and when the load resistance was changed, the amplification value decreased to equal (5).So the load resistance has become equal to:

A) The same resistance value connected between the collector and the Vcc.

B) Half the value of the resistance connected between the collector and the Vcc.

C) Two-Third of the value of the resistance connected between the collector and the Vcc.

D) Twice the value of the resistance connected between the collector and the Vcc

Q 14): A clipper circuit was connected with two identical ordinary diodes to give a result of a positive and negative clipping at same values, the two diodes were connected in:

A) Series with back to back direction

B) Series with face to face direction

C) Parallel with face to face direction

D) A+B

Q 15): I may derived that I could design a clamping circuit that has a DC voltage of +2.3V and with a 10Vp=p input signal by adding a DC battery equal to:

A) +1.3 V.

B) -1.3 V.

C) +2.0 V.

D) -2.0 V.

Q 16): A group of students has connected a full wave a bridge rectifier circuits with a high %ripple, then he made some improvements to his circuit until the %ripple = 3%.

Actually, this group of students use:

A) A capacitor = 100µF and a load resistor = 10K Ω

B) A capacitor = 100µF , a load resistor = 10K Ω and a high frequency input signal

C) A capacitor = 10µF , a load resistor = 10K Ω and frequency input signal=50Hz

D) A capacitor = 1µF , a load resistor = 10K Ω and frequency input signal=200Hz

(Part 5): Evaluation

Q 17: Ali connected some different types of electronic circuits in order to evaluate their high performance and effectiveness , and when he connected a clipping circuit he declined that this circuit is suitable to be used in a rectifier circuits. Ali was evaluated this circuit depending on

A)The shape form of the output signal.

B) The clipping voltage values for this circuit.

C) The frequency value of the input signal pulse.

D) All of the above

Q 18): When he also connected a clamping circuit; he declined that this circuit is more suitable and effective than other clamping circuit; His choice was build on because of choosing:

A) The value of the resistance connected in parallel with the capacitor.

B) The direction of the diode used in his circuit.

C) The value of the resistance connected in series with the input signal.

D) The value of the DC voltage that is in the output signal.

Q 19): And when he connected different types of amplification electronic circuits. he evaluate one of them to be high effectiveness and could be added to another circuits. He has chosen this amplifier taking into account the value of:

A) Amplification of the input signal.

B) The input impedance of the amplification circuit.

C) The output impedance of the amplification circuit.

D) All of the above.

Q 20): After several trials to connect amplification circuits, Muhannad take a decision that he prefers to use a full wave a bridge rectifier rather than a half wave rectifier because of the:

A) Use of double number of diodes.

B) Use a high value of load resistance.

C) Use a high value of capacitor.

D) Effectiveness of reducing the %ripple

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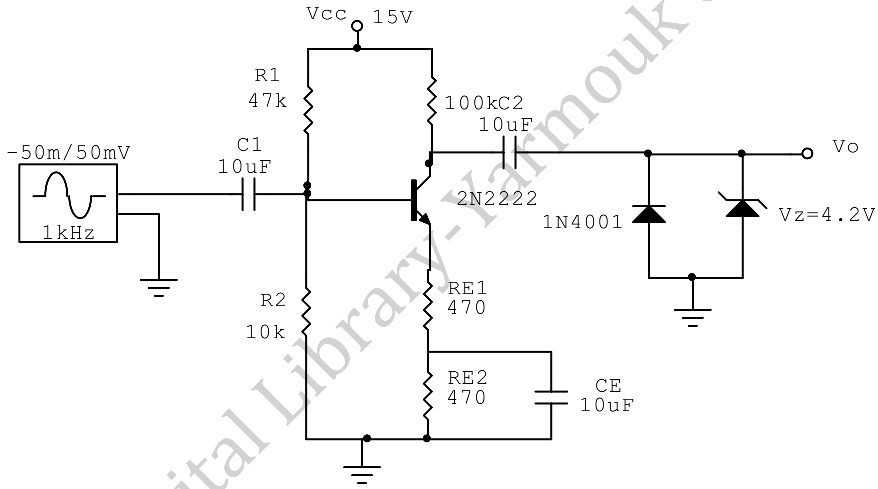
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		.ýƱƶ!ƒ ƔǤƙƪDž/Ɣƙƪ ƚƼƧɀdž! ýĂƬĂ!ƒ ǏǁƵ Ɣ!ƠƱ!ƒ ƖƧƥƿ -18
		ƔǤƙƪDž/Ɣƙƪ ǑŏơƬƙĂ ƚŋ!ǤɀDž! ýĂƬĂ!ƒ ǏǁƵ Ɣ!ƠƱ!ƒ ƖƧƥƿ -19 ýƱƶ!ƒ
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(20) ŝƠǁǆ

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ƕǕŧǅǇƞ ƪƐƥǋǅǆƞ ƒƑƨŧǀǕ ƕƜƟǕǅǆƞ ƕƺƑƯǤ

Acquisition of practical skills

The teacher asks the student to connect the following circuit shown in Figure 1. and then write down the following observations to know if the student enable to acquire the required skill by putting the sign (√) for the appropriate paragraph:

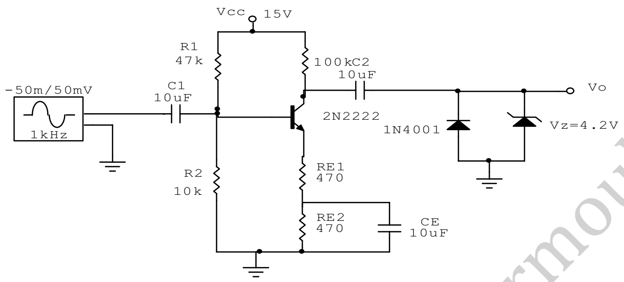


Figure.1

Practical skill required	Enables	Not enable
A) Skill of choosing the suitable component and devices		
1 - The student enables to choose the type of the required pieces (resistances, capacitors, diodes ...).		
2- The student enables to determine the values of the required piece.		
3 - The student enables to choose the signal generator for using it in the circuit.		
4 - The student enables to choose the oscilloscope for using it in the circuit.		
5 - The student enables to determine the values of voltages and frequency of the input signal generator		
6 - The student enables to choose voltmeter device for using it in the circuit.		
B – Connection skill:		
7 - The student enables to build all the elements of the electronic circuit.		
8 - The student enables to connect between the electronic parts.		
9 - The student enables to connect the signal generator as an input of the circuit.		
10 - The student enables to connect the oscilloscope on the output of the circuit .		
11 - The student enables to connect the voltmeter		

to measure the required values		
C - The skill of using devices:		
12 - Student's ability to use the signal generator and changes its values.		
13 - Student's ability to use the oscilloscope and run the circuit		
14 - Student's ability to use the voltmeter and changes its values.		
15 - Student's ability to use the battery and changes its values.		
D - Skill of identifying faults: The teacher observes the student through the followings: • If there is a fault /s faced with the student. • The teacher makes a fault /s and observes the students ability to do the following skills:		
16 - Student's ability to discover the fault by himself.		
17 - Student's ability to discover the place of the fault		
18 - Student's ability to determine the reason/s causes the fault.		
19 - Student's ability to reach a solution and if he can correct this fault		
E - Skill to get the results.		
20 – The ability to deal clearly with the oscilloscope device and run it..		
21 - The ability to change the X-axis and Y-axis for obtaining a clear signal.		
22 - The ability to take the results from the oscilloscope device.		
23 - The ability to record the readings from the voltmeter.		
26 - The ability to show and read the results on the oscilloscope for the2- channels (the input and the output signals)		
25 - The ability to read and record the results with accuracy as it is from devices.		
24 - The ability to show and read the results of the two coupling (AC & DC coupling) together the oscilloscope		

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				ƴǒƮĂƙ!ƒ	20		
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2	ƩƧƥ!ƒ ǑǈǴǀ!ƒ		ƾǎǈƺƙ!ƒ ƧƒĂƥ	ǂƅƪǴǈdž!ƒ ƚƎǌƞŮƒĂ ƴƠ!!ƒ ƧǴǒƙƤƒ	20		
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				YĂdžƞdž!ƒ	100		
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Experiment A

Part 1:Clippers Circuits	ţ sǁǫ ƥǝǫǋǭ - 1: ƕƓƥƜŧǁǫ ! ƨ ǫ
Part 2:Clampers Circuits	5ĭŧyŧǁǫ ƥǝǫǋǭ - 2

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1. Objectives: :ƕƓƥƜŧǁǫ DžDž Ƹ ǭǋǁǫ

To demonstrate the function of the clippers circuits.
To demonstrate the function of the clampers circuits.

2. Theory: :ƕƓƥƜŧǁ ǎ ƥƜǂǁǫ ƥƑƯŰǫ

clamping and Clipping circuits are circuits that shape or modify an ac signal. Clippind Circuits also called limiters. They limit or clip off the positive or negative part of the signal.

Clipper circuits are concerned primarily with limiting or cutting off part of the waveform, due to that they can be used for circuit protection or waveform shaping. It works as the principle of changing from the linear to the cut off region. The half wave rectifier is a zero level clipper; if want to change this level we simply add a biasing voltage to shift the operating point to the required value. In Figure (1-1) the diode is open (high resistance) if the input is less than the biasing voltage V_B plus the cut in voltage as shown in the graph (1-1) below.

If $Vin < VB + V\lambda$ *will result* $Vo = Vin$

Where $V\lambda$ is the cut in voltage.

If $Vin > VB + V\lambda$ *will result* $Vo = \frac{VinRf}{R+Rf} + \frac{R(VB+V\lambda)}{R+Rf}$ *, Rf is the Diode forward resistance)*

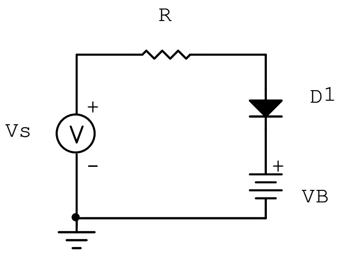


Figure 1-1

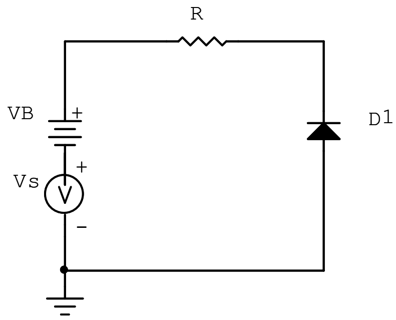
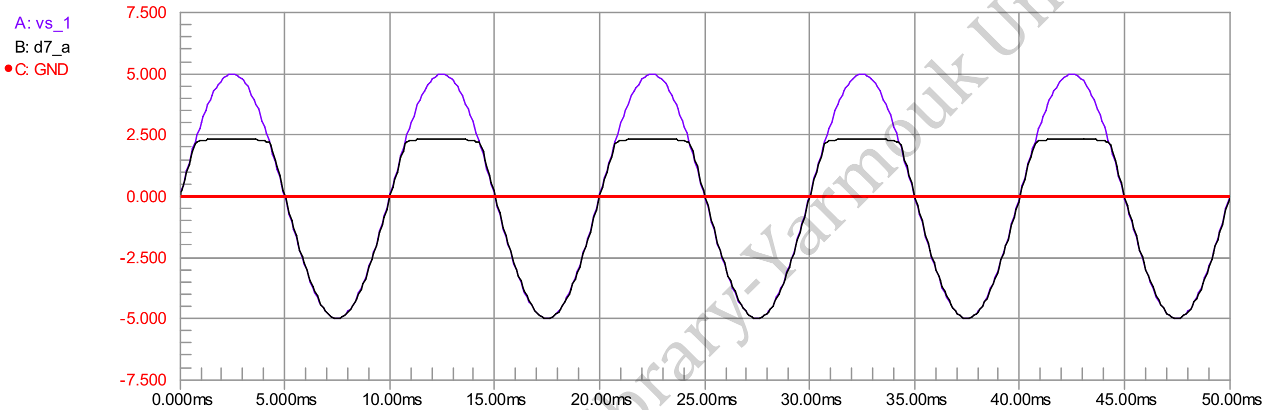


Figure 1-2



Graph (1-1)

The circuit shown in figure (1-2) is another type called the series biased clipper and it uses a dc source connected in series with the input source which causes the input signal to be superimposed on the dc voltage.

Clippers are used in many applications, one of them in TV set it detect the synchronous pulses.

The clamping circuit is a circuit that shifts a signal to remove negative fluctuations. It is also called a level restorer due to it's adding a dc level to the signal.

Figure (1-3) represents an example of a clamping circuit. The capacitor charges to it's peak value of the input voltage through the diode when the input voltage is negative. As the input is positive, the Vo voltage equals the dc voltage across the capacitor + the input voltage. Then RC (time constant) of the capacitor and the load ≫ the period of the Vs voltage, the capacitor have no enough time to discharge through R_L. So, the Vo voltage is the Vs shifted by a dc to keep the waveform positive. The graph (1-2) below shows the output of this clamping circuit.

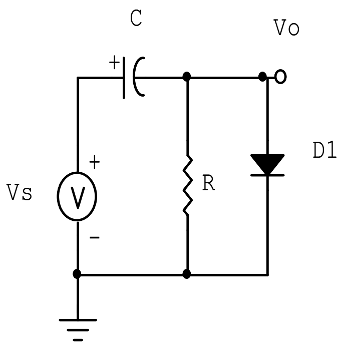
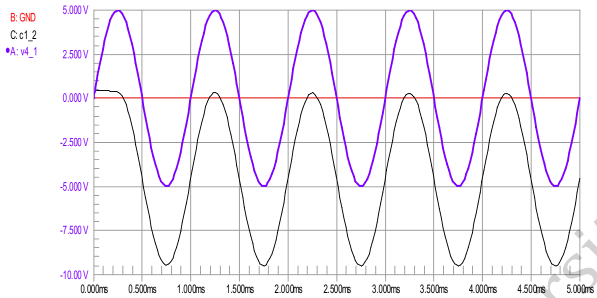


Figure 1-3



Graph (1-2)

Experimental Procedures:

Part 1: Clippers Circuits

How to use the circuit maker program

In order to connect the following circuit in figure (1-4) using the circuit maker program use the following steps:

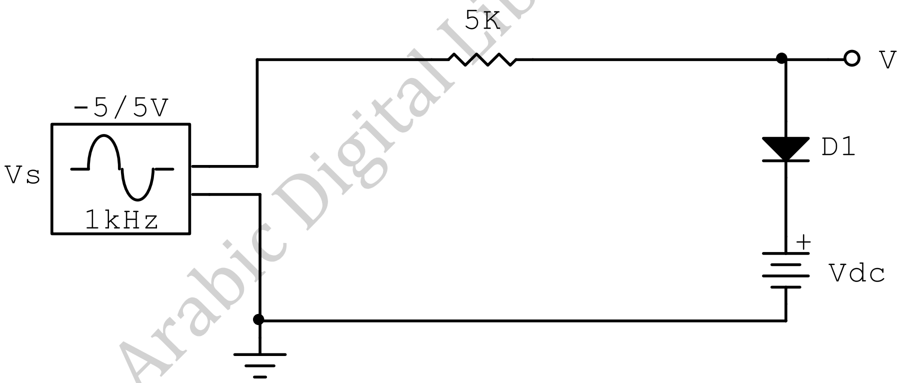


Figure (1-4)

1. Choose the needed components from the panel and place them in a suitable manner as shown in Figure (1-5)

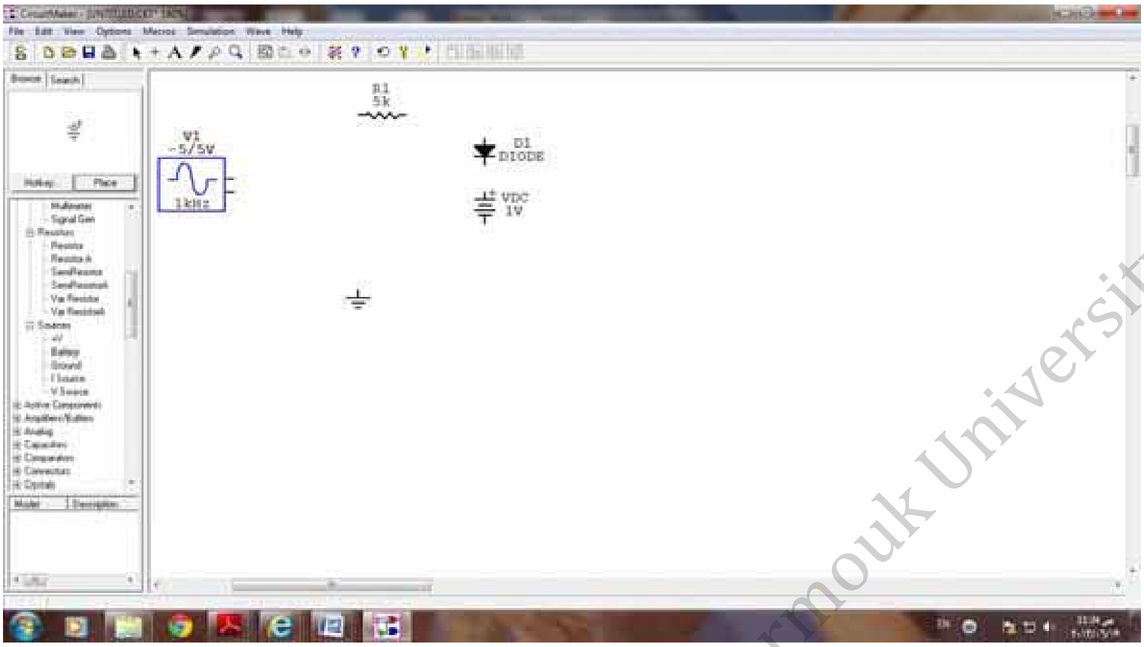


Figure (1-5)

2.Choose the suitable value for each component from the device properties as shown in Figure (1-6)

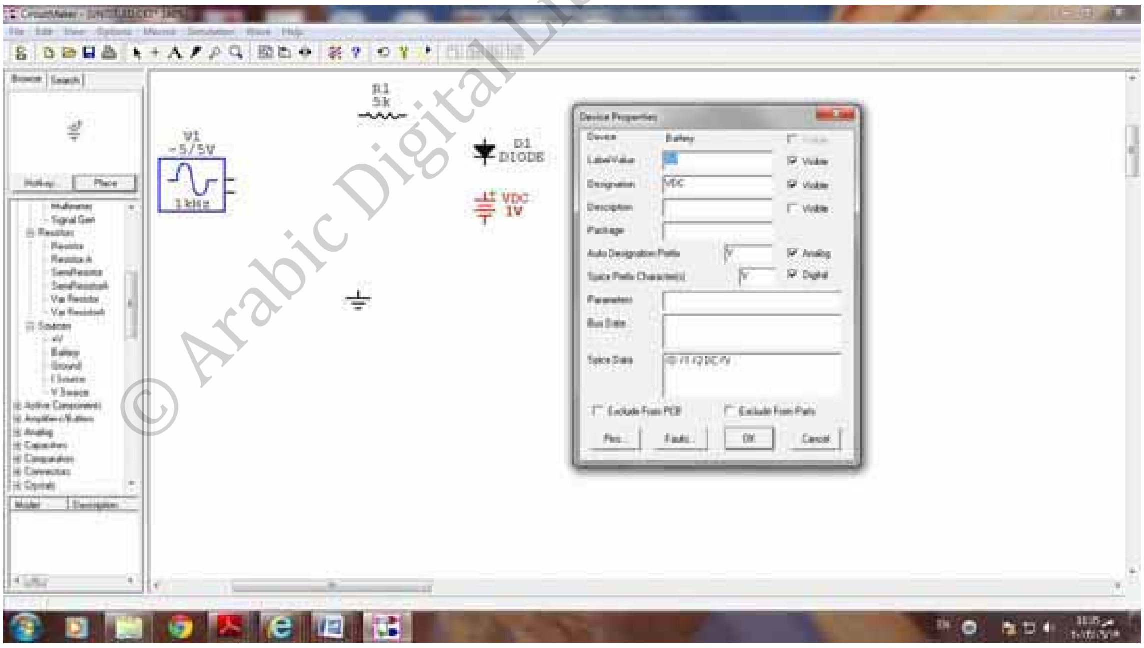


Figure (1-6)

3.Wiring between each component using the wire tool until you are finishing the circuit as shown in Figure (1-7)



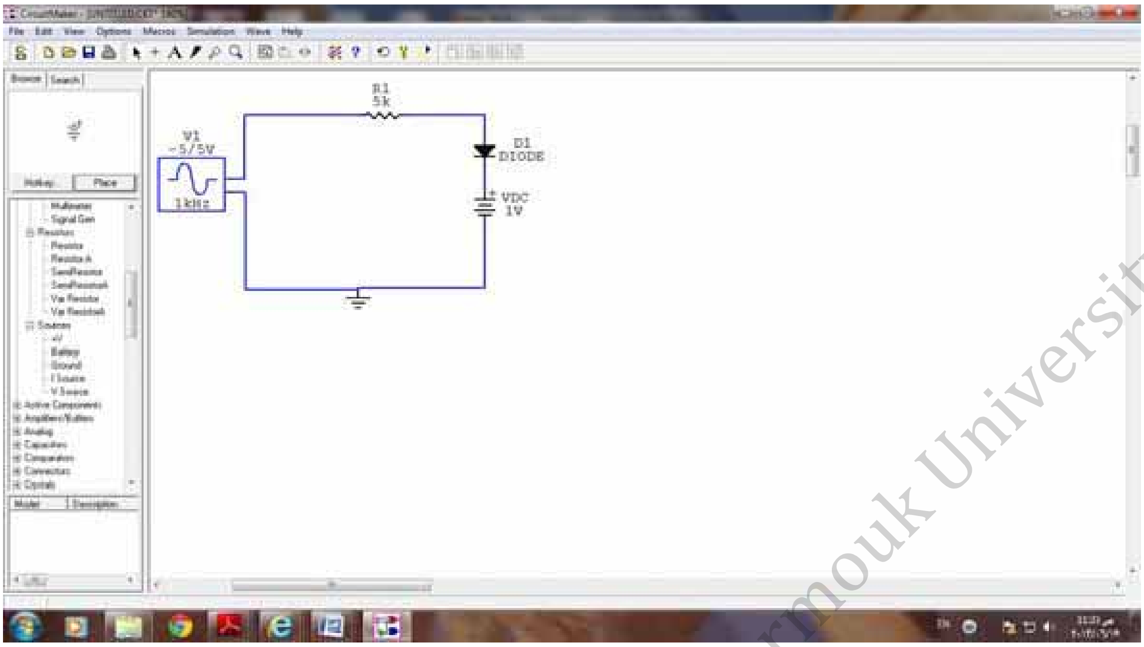


Figure (1-7)

4. Run the circuit using the run button then use the probe tool to see the input or the output or both of them as shown in Figures (1-8 , 1-9 , 1-10) respectively.

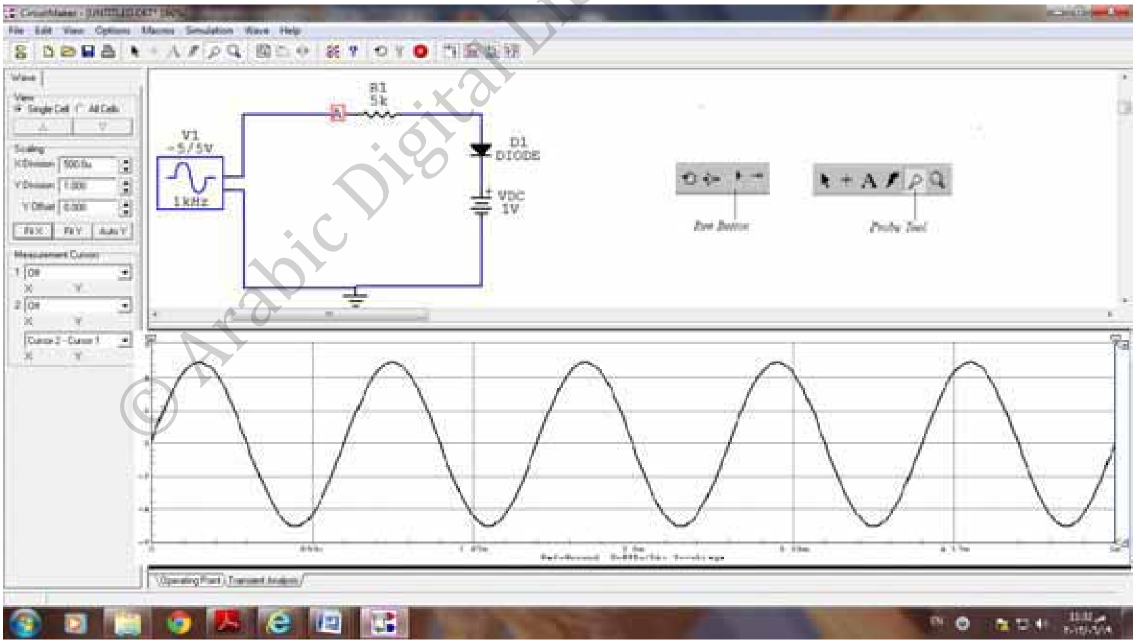


Figure (1-8)

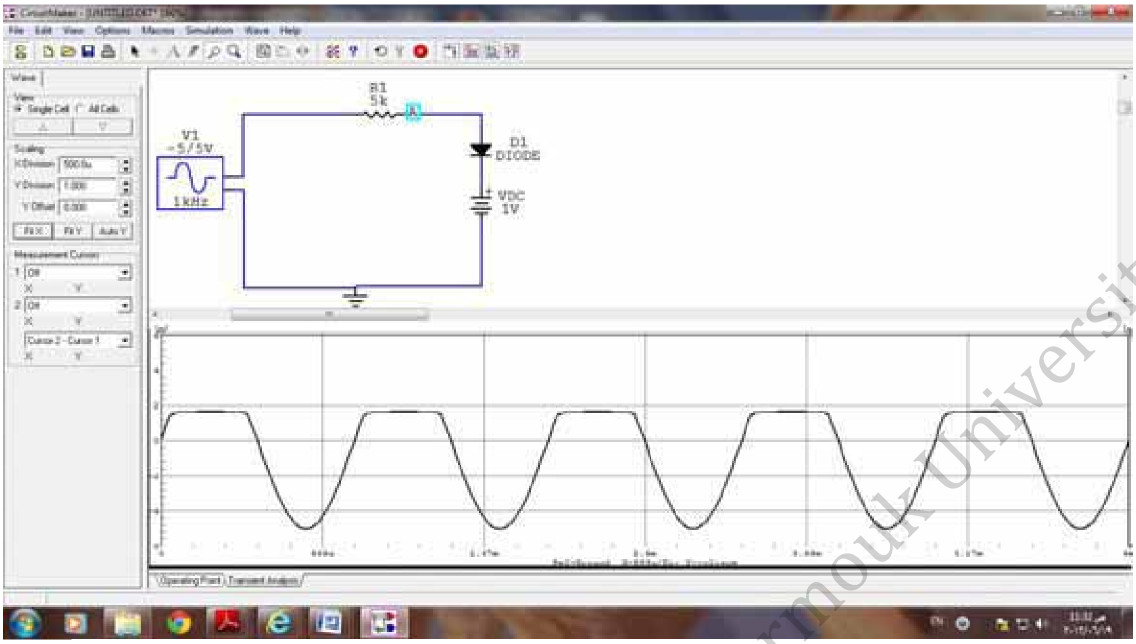


Figure (1-9)

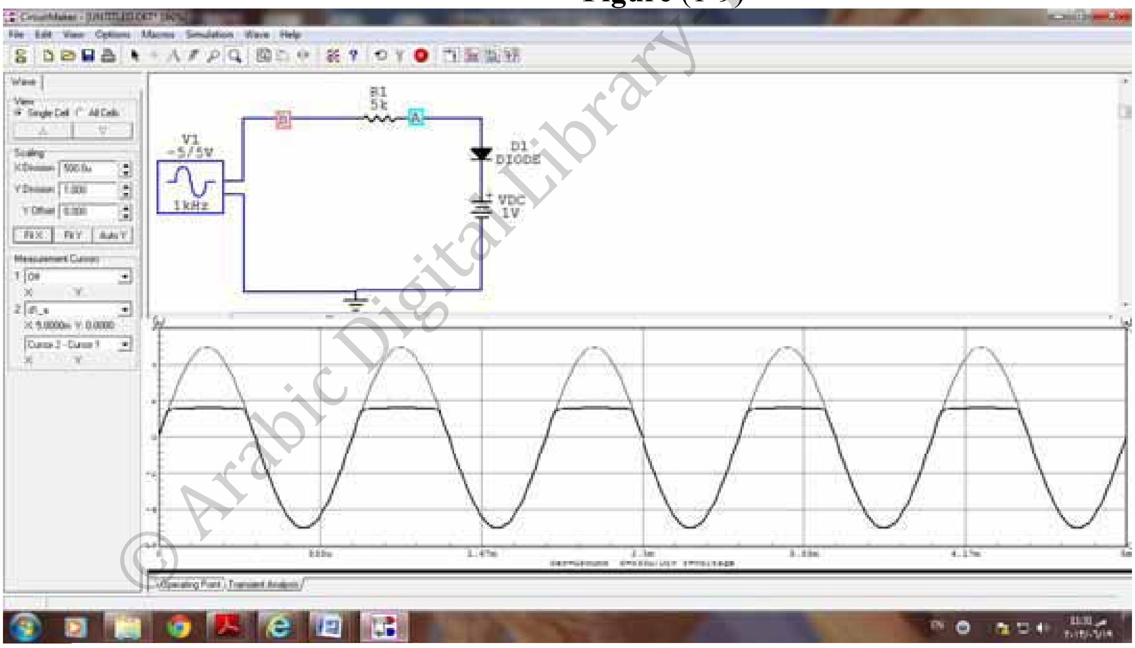


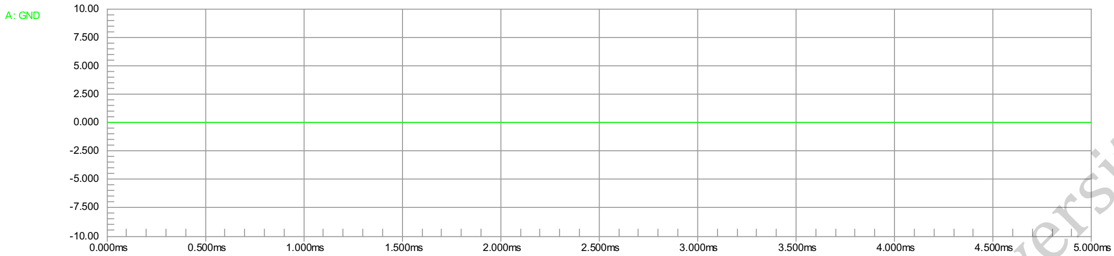
Figure (1-10)

2. Measure the Vp-p for both input and the output signals and put your results in table (1-1).

	+Vp-p	**_-Vp-p**	**Cutting Voltage**
Input signal			
Output signal			

Table (1-1).

3.Put Vdc=1 V , F=1 KHz measure and sketch the output waveform on graph (1-3)



Graph (1-3)

4.Vary the Vdc from 0 – 6 V then repeat the previous steps.

5. Put your results on Table (1-2) and graph (1-4) below

	+Vp-p	**_-Vp-p**	**Cutting Voltage**
Input signal			
Output signal			

Table (1-2).



Graph (1-4)

6.Put Vdc=1 V , F=1 KHz measure and then repeat the previous steps
7. Reverse the diode terminals then repeat the previous steps.

- Comment on the results

:……………………………………………………………………

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8. Connect the following circuit shown in figure (1-11) using the circuit maker program:

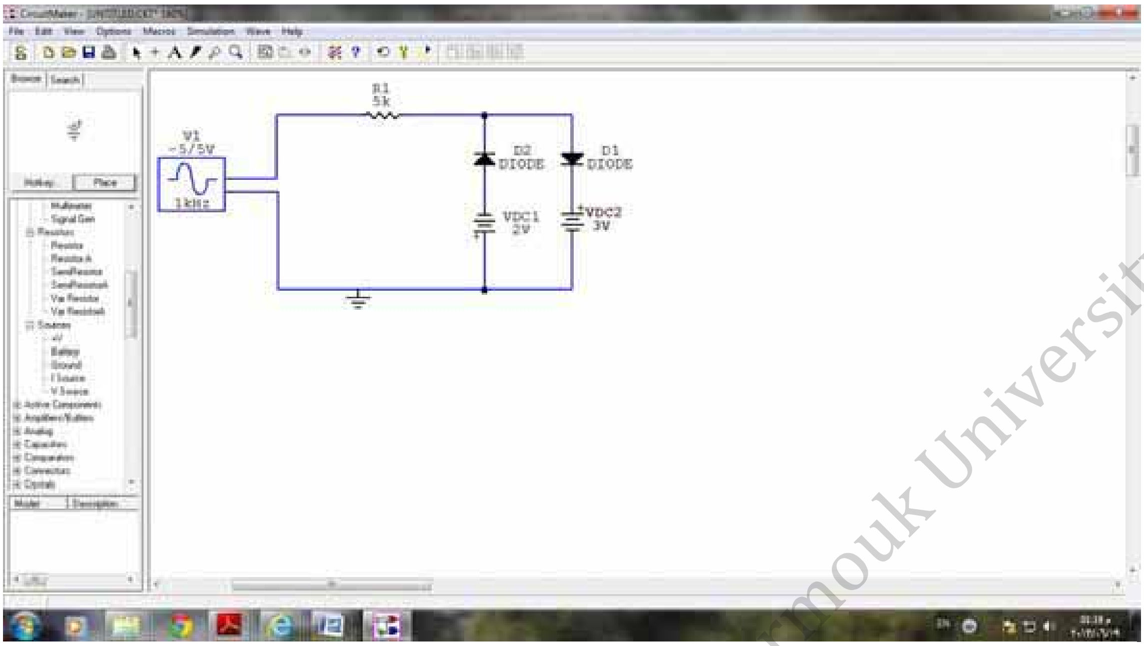
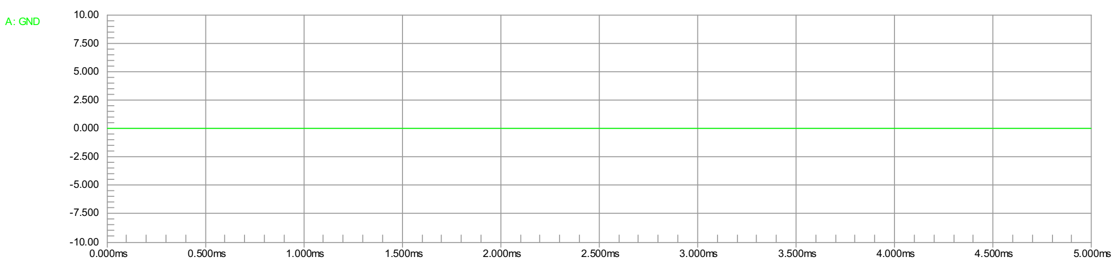


Figure (1-11)

9. Measure and sketch the input and output waveforms.
10. Repeat steps 2 to 5 and vary the DC voltages the pput your results in tabl1 (1-3) and grapg (1-5)

	+Vp-p	_-Vp-p	Cutting Voltage
Input signal			
Output signal			
VDC1=4V and VDC2=5V			
VDC1=6V and VDC2=6V			

Table (1-3).



Graph (1-5)

- Comment on the results
:……………………………………………………………………

Part 2: Clampers Circuits 5ĭŧyǂǁǁ ƥǝǽǸǰ :Ĭǳǩǁǁ ƃŖǁǁǁ

1. Connect the following circuit in figure (2-1) :

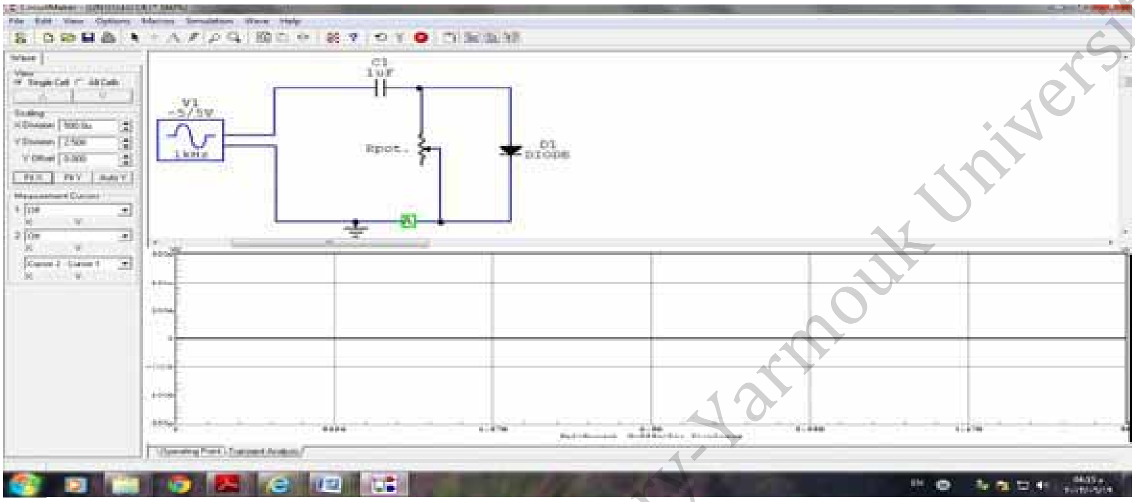
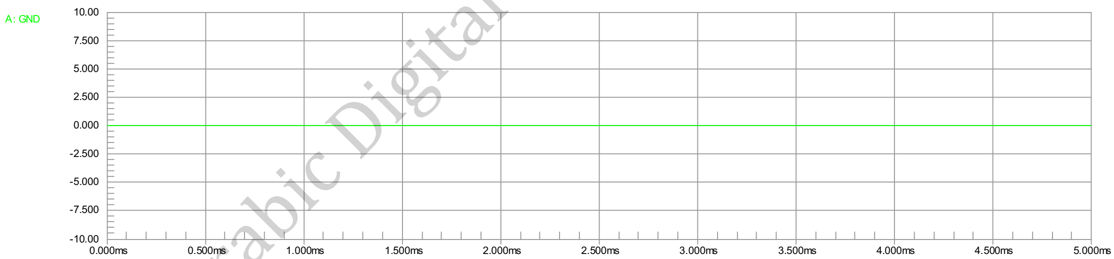


Figure (2-1)

2.With Rpot.=100KΩ, measure and sketch the output waveform on the graph (2-1).



Graph (2-1).

2. Decrease Rpot an increment of 10 and notice what happen.

3. Put Rpot.= 1KΩ .Explain what happen to the output.

5. Connect the following circuit in figure (2-2):

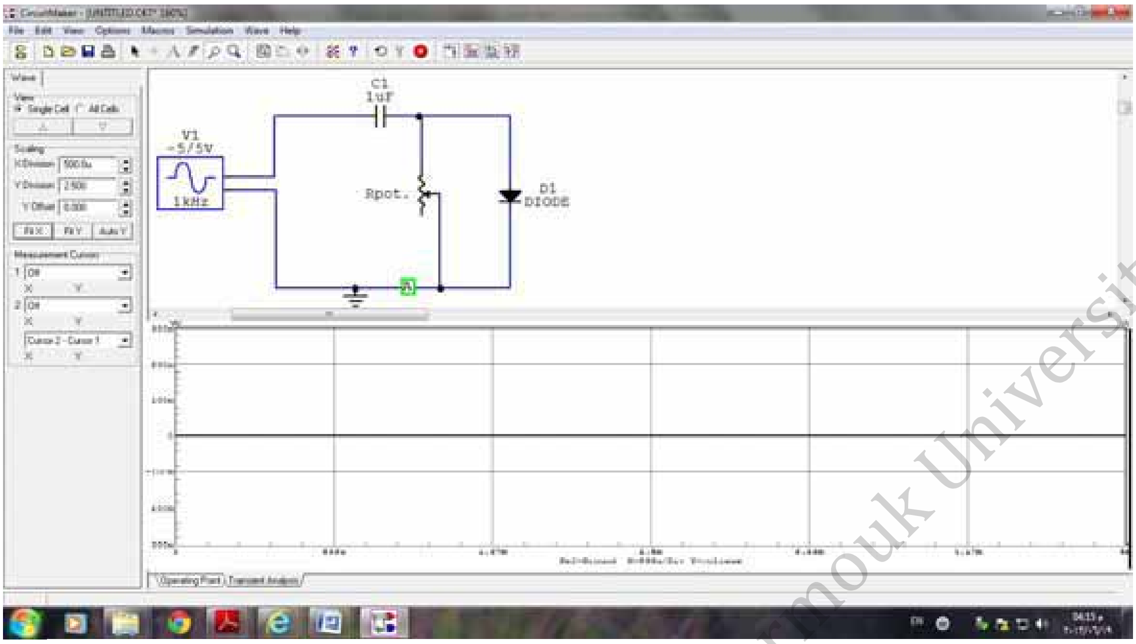


Figure (2-2)

6 Measure and sketch the input and output waveforms.

7.Vary Vdc from 0-3v then measure and sketch the corresponding outputs.

- Diode applications (a simple digital logic gates):

1. Connect the following circuit in figure (2-3) :

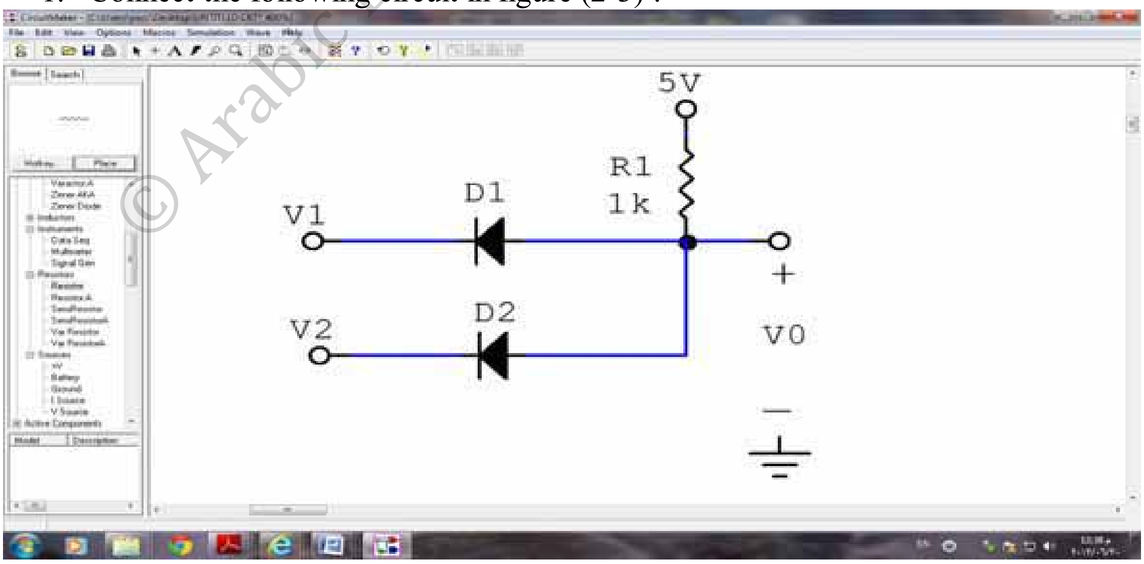


Figure (4-7)

2. Measure and record the values of Vo at each combinations of the values of V_1 and V_2 in the table (2-1) shown below. Explain.

V_1(volts)	V_2(volts)	V_O(volts)
0	0	
5	0	
0	5	
5	5	

Table (2-1)

- Comment on the results

:………………………………………………………………

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Experiment B

Rectifiers Filters and Ripple	!ǏǋǆƗǁ ƥƋǋƍ :ƕƓƥƜƗǁ ! ƨ Ɛ
Part 1: Half wave rectifier	ǇƜǋǊǈǁ Ʃ Ƭǘ !ǏǋǆƗ ƔƥƋƐƍ - 1
Part 2: Full wave rectifier	ǇƜǋǊǈǁ ǘǈƑ! !ǏǋǆƗ ƔƥƋƐƍ - 2
Part 3: Regulated Full wave rectifier	ǇƜǋǊǈǁ ǘǈƑ! !ǏǋǆƗ ƔƥƋƐƍ - 3 ƕǈƲǘǉǈǁ

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1:Objectives:

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- To construct half-and full-wave rectifiers .
- To investigate the use of capacitor filters to reduce ripple
- To demonstrate how loading of power supplies affects ripple.
- To demonstrate Voltage regulation.

2:Theory:

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In almost every DC power supply a rectifier circuit and a filter capacitor are used to convert an AC voltage to a pulsating DC voltage and then to smooth out the pulsations over time .Rectification is the process of turning an alternating signal into on that is rectified to only one direction .The average value or dc value –which is defined as the integral of the signal over one period of sine wave is zero, so to get a dc voltage from the ac it must be rectified .The Fourier expansion of the output results in the average value(DC)+ other high frequency components than can be reduced by using a low pass filter.

The circuit shown in Figure.(3-1) below shows the Basic power supply circuit using half-wave rectifier. A source of AC (represented by Vin), drives a transformer, which might step up or step down the voltage. Figures 3-2.a and 3-2.b shows the difference between outputs for this rectifier with and without the capacitor.

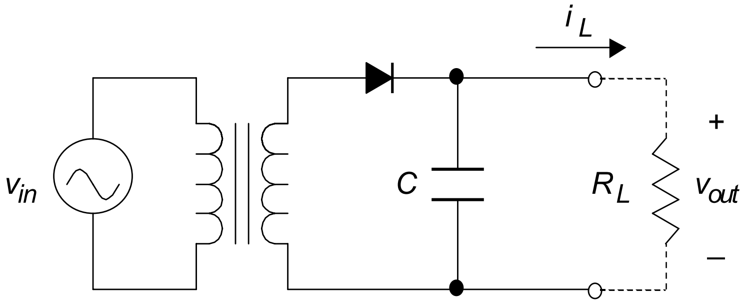
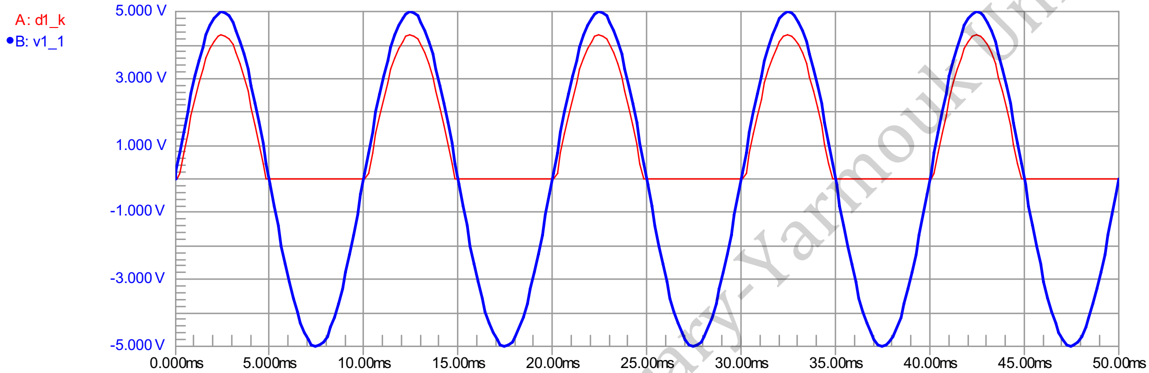


Figure (3-1). Basic power supply circuit using half-wave rectifier



Figure(3- 2a). The output waveform of the half-wave rectifier without using C

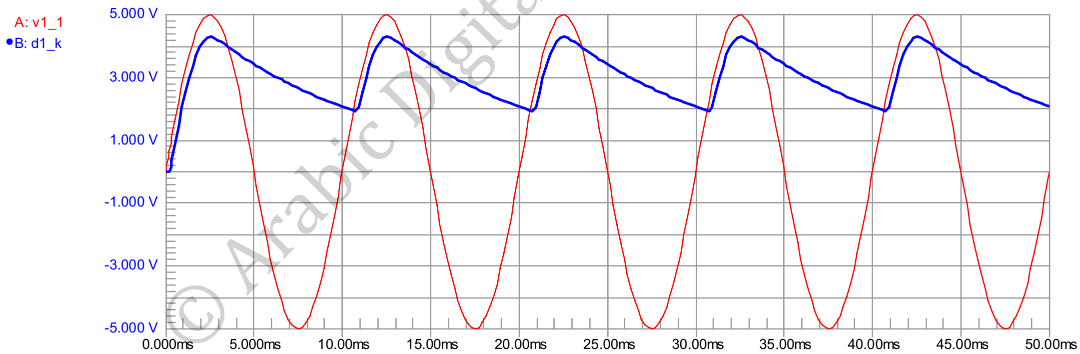


Figure (3- 2b). The output waveform of the half-wave rectifier using C

During the positive cycle the capacitor charging to the peak and during the negative cycle the capacitor discharge through R_L which results in a ripple that depends on the rate of discharge and the repetition of the input signal as seen in figure (3-3)

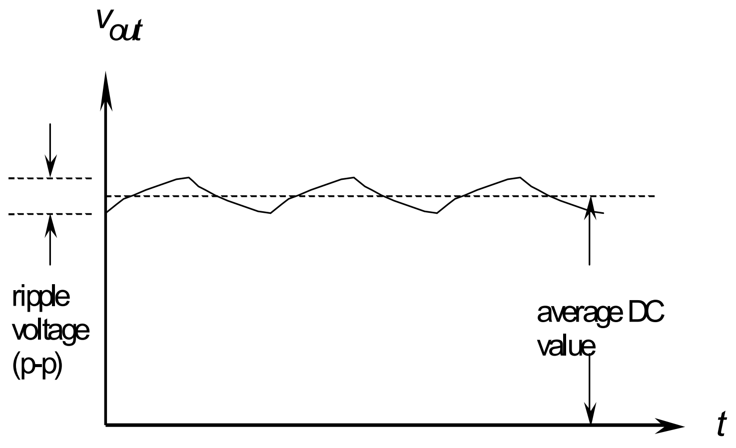


Figure (3-3). Ripple voltage in the output of a DC power supply.

The % ripple is a measure of the effectiveness of the filter and is given by:

$$\%\,\text{ripple} = \frac{\text{rms value of the ripple voltage}}{\text{average DC voltage}} X100\% \qquad (1)$$

Where the rms value of the ripple is given by :

$$\text{Vrms} = \frac{\text{Vp - p(of the ripple)}}{2\sqrt{3}} \qquad (2)$$

The % ripple can be calculated from the circuit components :

$$\%\,\text{ripple} = \frac{1}{2\sqrt{3}R_L C F_r} \qquad \textbf{(3)}$$

Where :
C: is the filter capacitor.
R_L: is the load resistance.
F_r: is the frequency of the output waveform of the rectifier.

Increasing the frequency can decrease the % ripple so we can use the full wave rectifier circuit like the one shown in Figure (3-4). In this circuit, diodes D2 and D4 conduct during positive half-cycles (when the top end of the transformer secondary is positive), and diodes D1 and D3 conduct during negative half-cycles. Thus, during both half-cycles current flows downward through the load resistor, so this circuit is a rectifier. The full-wave rectifier is an improvement over the half-wave circuit because the capacitor is charged during both half-cycles. Consequently, the capacitor does not have as much time to discharge, and the output voltage does not drop as much. For a given capacitor value, the output voltage remains more stable than with the half-wave circuit, and the ripple voltage is much smaller in magnitude.

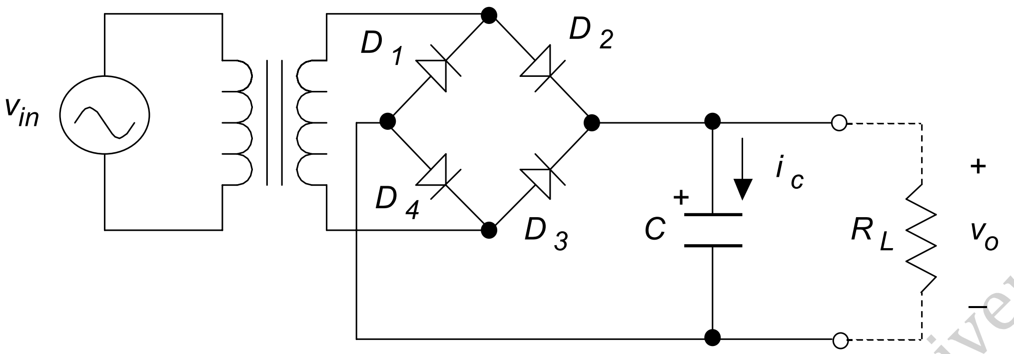


Figure (3-4). Full-wave bridge rectifier circuit with filter capacitor.

The required value of C is easily determined by:

$$i_c = C\frac{dv_o}{dt} \qquad (4)$$

The dc and rms voltages of both half wave and full wave rectifiers are given by

$$\text{Vdc(half-wave)} = \frac{\text{Vm}}{\pi} \qquad \text{Vrms(half-wave)} = \frac{\text{Vm}}{2}$$

$$\text{Vdc(full-wave)} = \frac{2\text{Vm}}{\pi} \qquad \text{Vrms(full-wave)} = \frac{\text{Vm}}{\sqrt{2}}$$

Experimental Procedure: :ƕƓƥШǁƸ ǀ ƐǋƯƠ

Part 1: Half wave rectifier ǇǋШǋǆǁƸ ƹ Tǚ !ǏǋƫƗ ƔƥƏƐ :üǋǓƸ ƀƦШǁƸ

1. Connect the following half wave rectifier circuit in figure (3-5) :

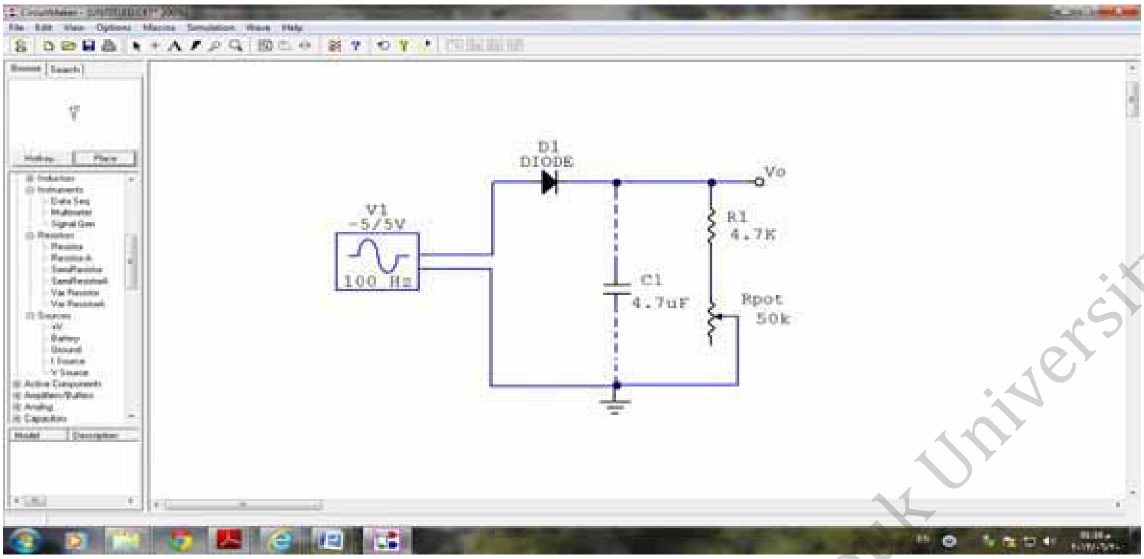


Figure (3-5).

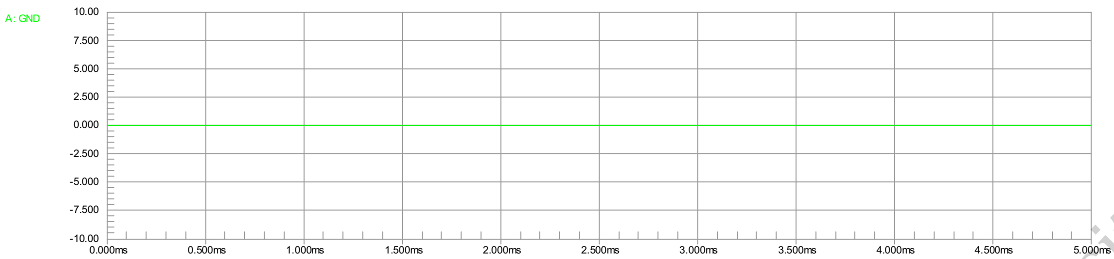
2. To investigate the effect of the load resistance and the capacitor on the % ripple:

a-Vary the input voltage until the output peak is 5V(with the capacitor is disconnected) Measure and sketch output voltage wave form

b-Connect the capacitor then vary the potentiometer from it's minimum to the maximum value .Measure and sketch the ripple and the dc of the output. Explain the results. Put your results on table (3-1) and graph (3-1)

Half wave rectifier	**Vp-p**	**V_{DC}**	**Vrms**	**%ripple**
Input signal Vp-p=5V				
Output signal Without Capacitor				
Output signal with Capacitor				

Table (3-1).



Graph (3-1).

Part 2: Full wave rectifier

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3. Connect the following circuit in figure (3-6):

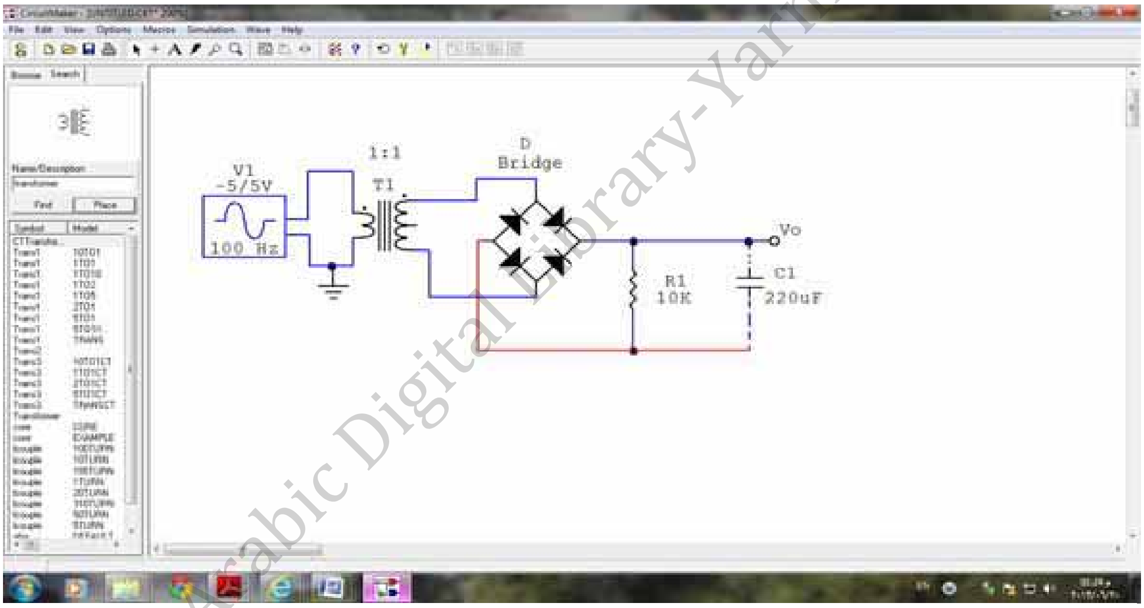


Figure (3-6).

4.With the capacitor is disconnected; Measure and sketch the output voltage wave form.

5. Connect the capacitor to obtain a dc voltage from this circuit.
(Note the difference between the ac and dc coupling of the oscilloscope).

6. Measure and sketch the output voltage wave form (dc and ac components).

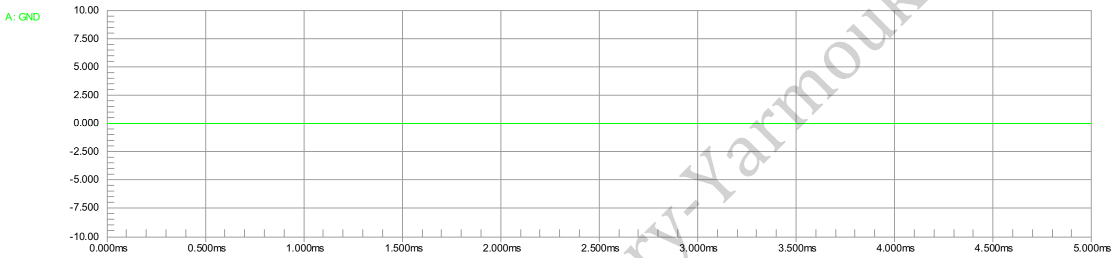
7. Calculate the % ripple using the measured data.

8. Replace the capacitor by 47µF the repeat parts 7and 8.

9. Put your results on table (3-2) and graph (3-2)

Full wave rectifier	Vp-p	V_{DC}	Vrms	%ripple
Input signal Vp-p=5V				
Output signal Without Capacitor				
Output signal with Capacitor				

Table (3-2).



Graph (3-2).

Part 3: Regulated Full wave rectifier

10.Connect the following circuit in figure (3-7).

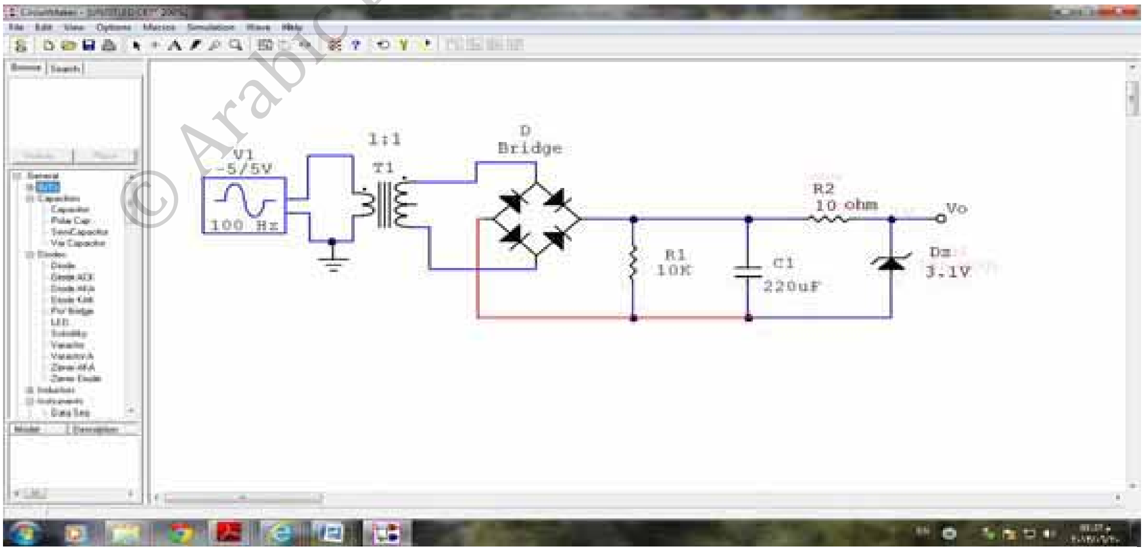


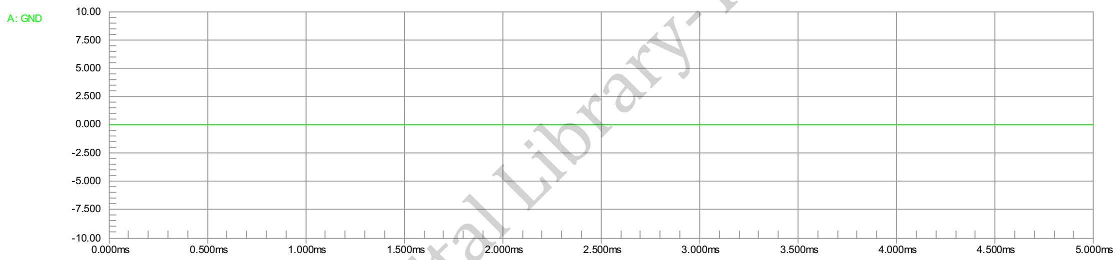
Figure (3-7)

11-Measure the ripple and the dc value of the output.

13. Put your results on table (3-2) and graph (3-2)

Regulated Full wave rectifier	Vp-p	V_{DC}	Vrms	%ripple
Input signal Vp-p=5V				
Output signal Without Capacitor				
Output signal with Capacitor				

Table (3-3).



Graph (3-3).

Note:(Calculating the value of the capacitor)

If the ripple is a small percentage of the total output voltage, then the voltage across the capacitor decays almost linearly. For a full-wave rectifier, the next input voltage peak occurs one half-period (T/2, where T is the period) The time derivative of the output voltage over the half-cycle can therefore be approximated as:

$$\frac{dv_o}{dt} \approx -\frac{v_{\max} - v_{\min}}{0.5T},$$

$$i_c = C\frac{dv_o}{dt} \approx -C\frac{v_{\max} - v_{\min}}{0.5T} =$$

$$\Rightarrow i_c = \frac{v_o}{R_L} \approx -C\frac{v_{\max} - v_{\min}}{0.5T}$$

$$\frac{\Delta v_r}{v_{o,avg}} = \frac{0.5T}{R_L C}$$

$$\boxed{\Rightarrow C = \frac{0.5T}{R_L}\frac{1}{\left(\Delta v_r / v_{o,avg}\right)} = \frac{1}{2fR_L}\frac{1}{\left(\Delta v_r / v_{o,avg}\right)}}$$

For example: If the percentage ripple is 5%, then $\Delta v_r / v_{o,avg} = 0.05$).

- Comment on results: ………………………………………….........

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Experiment C

Amplifiers	!ƨƸ !ĭƣƮƗƸ ƥƥƸǋƣ :ƕƓƥƜƗƸ
Part 1: Common Emitter	ƘƳƑƓƸ ƒ ƥǅǅ !ĭƣƮƗ ƴƥƥƸƣ -1
Part 2: Common Collector Amplifier	ƱǅƑƜƸ ƒ ƥǅǅ !ĭƣƮƗ ƴƥƥƸƣ -2

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1:Objectives: :ƕƓƥƜƗƸ ǅǅ Ʃ ƣǋƸ

1- To demonstrate the operation and characteristics of small signals common emitter and common collector amplifiers.
2-Analyze the dc operation.
3-Analyze the ac operation.
4-Determine the input resistance.
5-Determine the output resistance.
6-Detrmine the voltage gain.
7-Explain the effects of an emitter-bypass capacitor.
8-Demonstrate swamping and discuss its effects.
9-Demostrating the effect of a load resistor on the voltage gain.
10-Demonstrating the phase shift.

2:Theory: :ƕƓƥƜƗƀ ă ƥƜƸ ƥƑƯǕƸ

1-The common emitter amplifier is characterized by moderate input impedance and slightly high out put impedance. Both the voltage and current gain are high resulting in power gain. The common emitter amplifier can be considered as a current source with respect to the following stages.
To analyze the amplifier in Figure (4-1),the dc bais values must be determined. To do this, a dc equivalent circuit is developed by replacing the coupling and bypass capacitor with opens the dc circuit becomes as in figure (4-2) and the equivalent circuit as in figure (4-3)

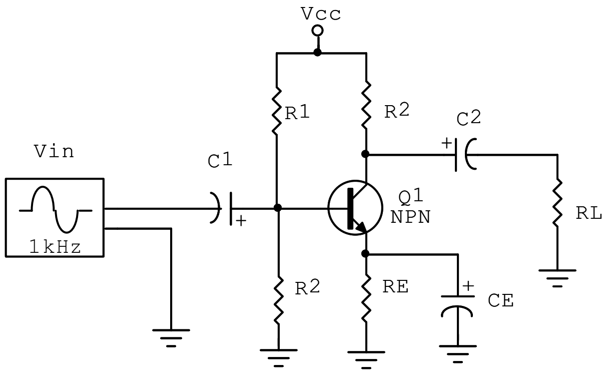


Figure (4-1)

$$VB = \frac{R2}{R1 + R2} Vcc$$

$$V_E = V_B - V_{BE}$$

$$IE = \frac{VE}{RE}$$

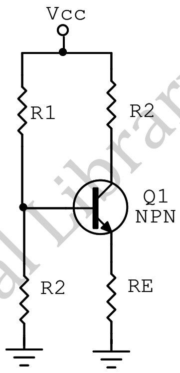


Figure (4-2)

$Vc = Vcc - IcRc$

$V_{CE} = Vc - V_E$

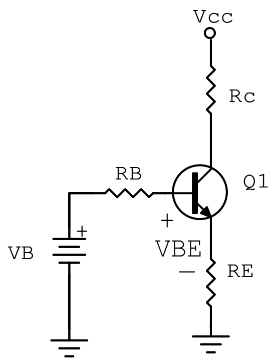


Figure (4-3) DC equivalent circuits for the amplifier

For analyzing the ac signal operation of amplifier, the equivalent ac circuit is developed as in figure (4-4): The capacitors C_1, C_2, and C_E are replaced by shorts because we assume that Xc= 0 ohm at the signal frequency.

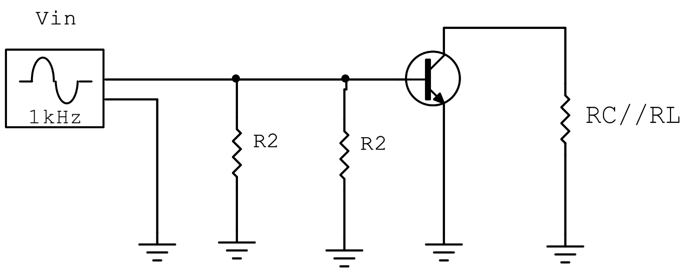


Figure (4-4) AC equivalent circuits for the *amplifier*

$R_{in} = R_1 \,//\, R_2 \,//\, \beta r_e$

$R_{out} = R_c \,//\, R_L$

$$Av = \frac{Rc \,//\, RL}{re}$$

$$Av\ (no\ load) = \frac{Rc}{re}$$

$$Av\ (unbypass) = \frac{Rc \,//\, RL}{RE + re}$$

2-The common collector amplifier is also the emitter follower. The term follower comes from the fact that the output voltage follows the input signal closely. The CC amplifier has a voltage gain that is less than unity, whereas its current gain is high. This amplifier is widely used as an impedance transformer when the level of a load is needed to be raised. This is because of its high impedance. An emitter-follower circuit with voltage-divider bias is shown in figure (4-5). Notice that the input is at the base, the output is at the emitter, and the collector is at ac ground.

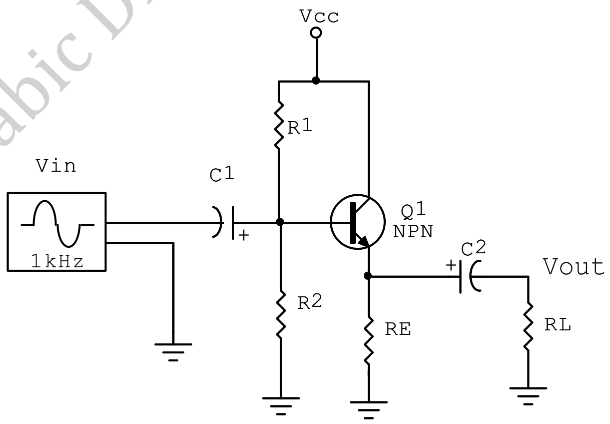


Figure (4-5).

■DC formulas:

$$Vb = \frac{R2 \,//\, \beta dcRE}{R1 + R2 \,//\, \beta dc\mathrm{Re}} Vcc$$

$V_E = V_B - V_{BE}$

$$I_E = \frac{VE}{RE}$$

$V_C = V_{CC}$

$V_{CQ} = V_{CC} - V_E$

■ **AC formulas:**

$$re = \frac{26mV}{IE}$$

Rin=R1//R2//β(re+RE)

With the load removed, the output resistance looking into the emitter of the emitter follower is approximated as follows in figure (4-6)*:*

$$Rout = \frac{Rs}{\beta} // RE$$

$$Av = \frac{RE}{re + RE}$$

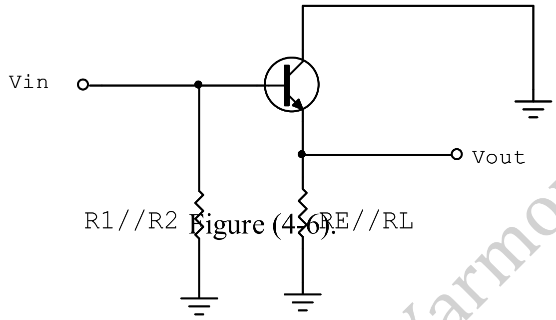


Figure (4-6).

Experiment procedure: :ɦǤƥɯɨǁ l ƐǋǙƯƣ

Part 1: Common Emitter amplifier: ƘƳƒǉǁ ƒ ƥƉǅ !ǐƣƮƗ ƔƥƏƐƣ :ǖǋǙǁ ƀƦɯǁ

1- Construct the following circuit shown in figure (4-7):

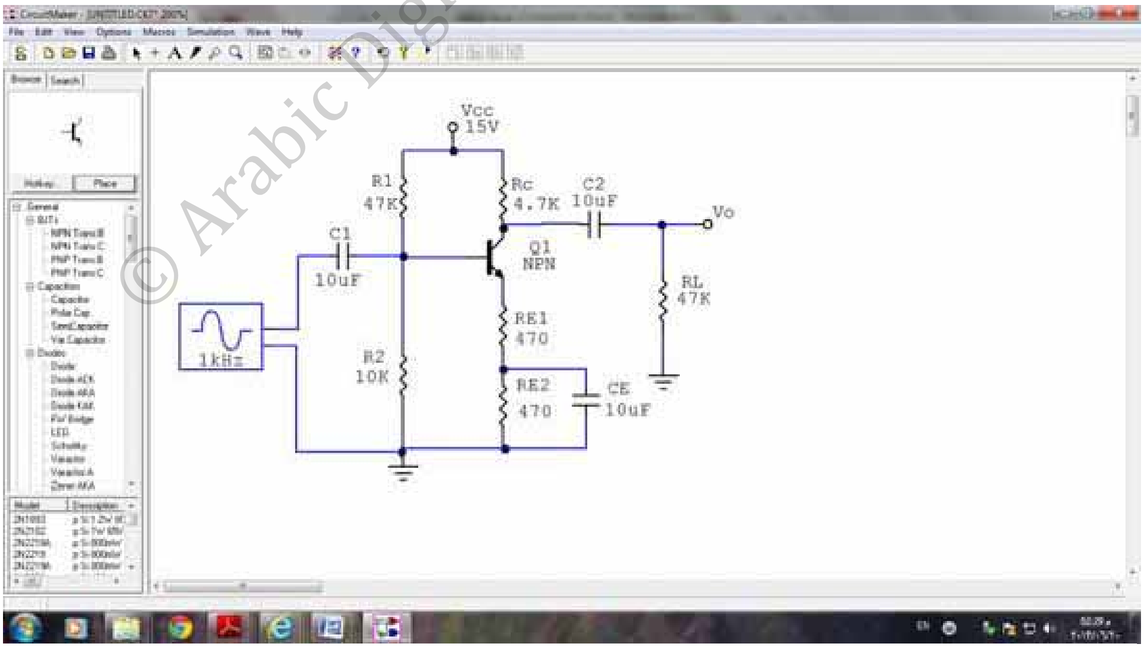


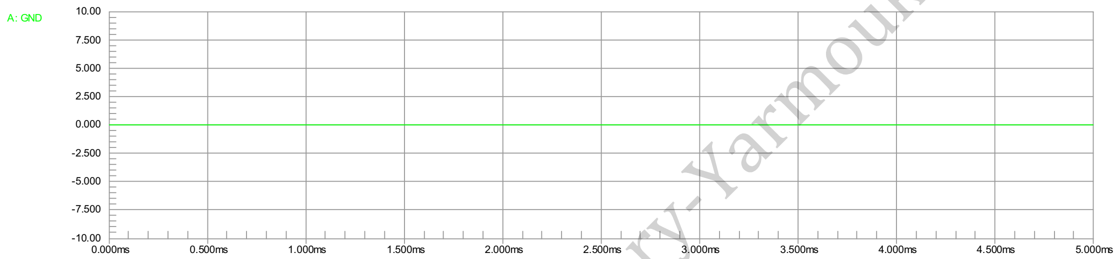
Figure (4-7)

1-Measure the biasing dc values and record the values in table (4-1), from the measured value Determine re.

Parameter	Measured Value	Expected value
V_B		
V_E		
V_C		
V_{CEQ}		
I_{CQ}		
r_e		

Table (4-1)

2- From these measured values draw the dc load line and locate the Q-point on graph (4-1).



Graph (4-1)

3- Apply a certain signal to the amplifier (Vin) until you see undistorted output then measure the following Values in table (4-2):

Common Emitter Parameters	Measured Values	Expected Values
Av		
Rin		
Rout		
Av (No Load)		
Av (RL=1k)		
Av (unbypass)		
Vout (maximum)		
Phase relationship between (Vout & Vin)		

Table (4-2)

Part 2: Common Collector amplifier

1- Construct the following circuit in figure (4-8):

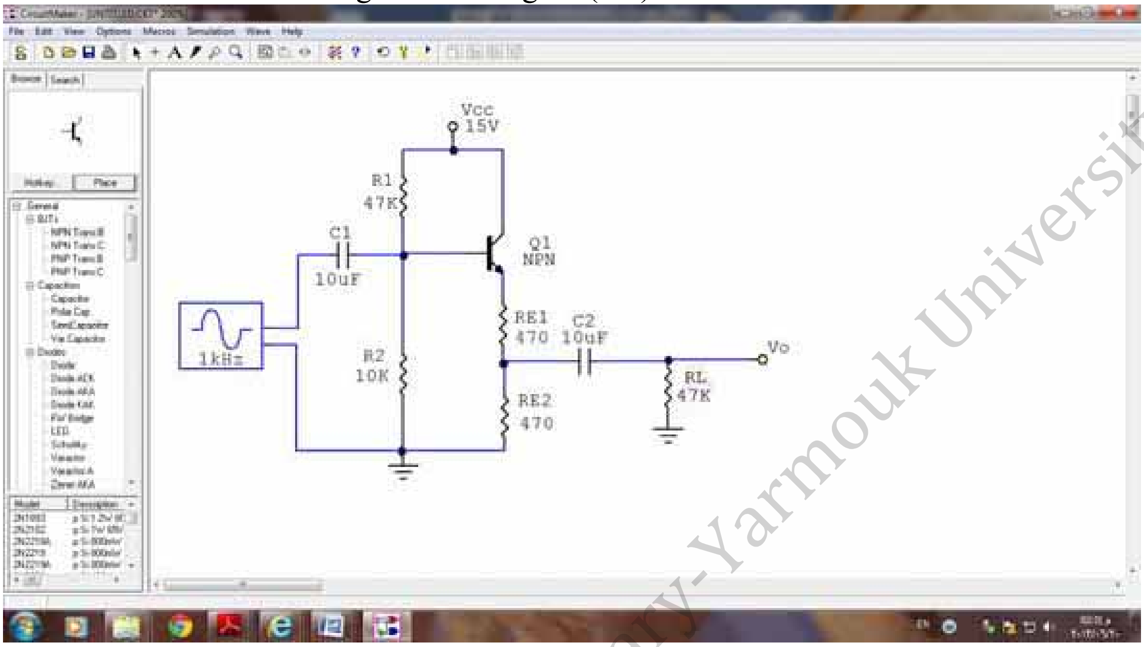


Figure (4-8)

2- Measurer Av, Rin, Rout, and the Phase relationship and record them in table (4-3):

Common Collector Parameters	Measured value	Expected value
re		
Av		
$A_{V(NL)}$		
Rin		
Rout		
Av (with load 100Ω)		
Phase relationship between (Vout & Vin)		

Table (4-3)

- Results and Discussion:……………………………………….....................

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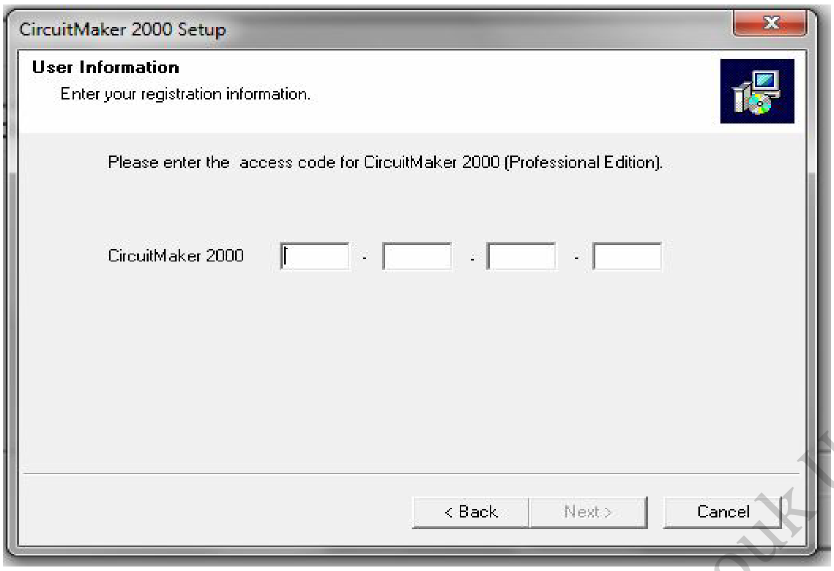


.ĎƥƤƘƮďžǃƒ ĎžƮƒ Ăƒ ŀŧƧTǃƒ ĎžƮƒ ƘŏǜƘ :3 ýŀT

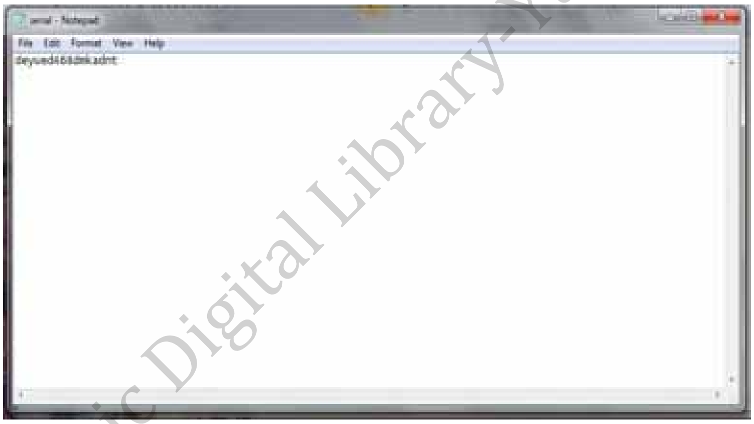
ŀ ùŏơ ÜƘǴùǉǡP ƴùƅƧƒ Ŏ5 ýƮǃƮƘďžǃƒ ĎƥƧǃƒ ƔǃƱƘ ŎƘǃƒĂ 4 ýŀT ǀȒ5ǴǉǃƒƧǌƲƘ ƧĂƮ ǴǴǌƘǉŪƒ ƥžƅ

ƱǯùưƒĎžùƛ 6 ýŀT Ŏ5 Ǵďžŀ ǋƘƑƅžƘ ĎƘƘ Ǵǋƥžƅ 5 ýŀT ĂǋǬ Ǵďžŀ ŀŏƞďžƧǜǃƒ Ʃ5ǉ ǇǇďž ĎƥƧǃƒ ȒPƋŏ

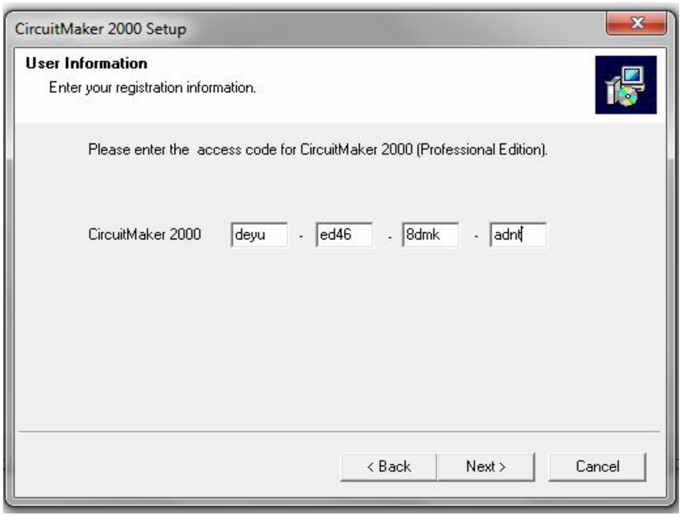
.Next Ƨƨ ĬŀŽ



ý ʅ ǚ ʅ kdž!ƒ Džp Ƨ!ƒ Ɣ ǚ Ʊ :4 ý‡T

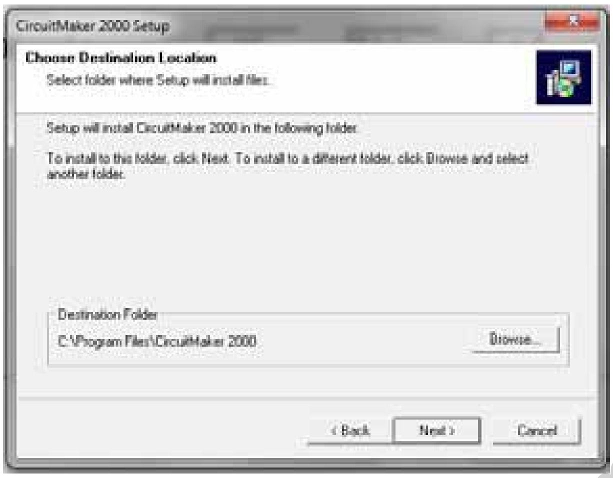


ý ʅ ǚ ʅ kdž!ƒ Džp Ƨ!ƒ Ǐ ǚ Ʒ ý Ǎ Ʈ ơ!ƒ :5 ý‡T



ý ʅ ǚ ʅ kdž!ƒ Džp Ƨ!ƒ Ŧ ƒhzk :6 ý‡T

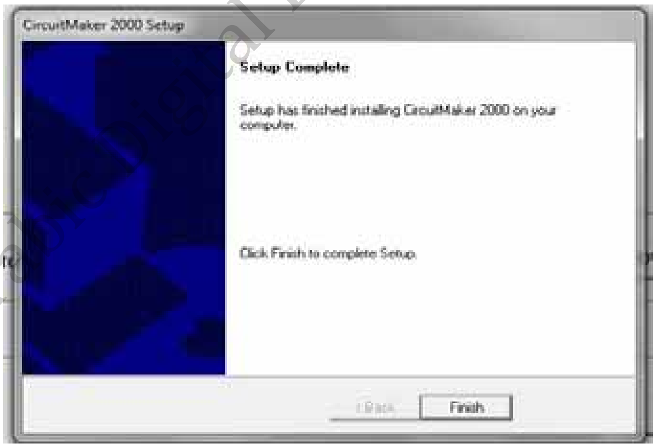
ƨĜùnjŋ Ǐ ùǁŽ ŇďĜùǇƨƾ!ƒ ƘĜùƽǁďǐ ýŏƨǇǩ) ƔŏƮǇǩ!ƒ ƚŏǁďŽ ƚŏƒƥƾ ƠƴǍŏ 7 ý‡T!ƒ -1
.Next ǏǁŽ ƱƺƴƒĈĜnjǨǇǕƒ ƥƶƾǍ (ƨǩǍŏƾďǂ!ƒ



ƨǩǍŏƾďǂ!ƒ ƨĜnjŋ ǏǁŽ ŇďĜǇƨƾ!ƒ ƘĜƽǁďǐ ýŏƨǇǩ ƚŏƒƥƾ :7 ý‡T!ƒ

ǅǐǍ ǁǩƤƪǇ ƚ ŏƥơǩ Ŏ5 ǺƴŏǑ ƨĜŏǩƤǕƒ ǁŏƱƶŏǍ Ƙďǩ ƥƥ ƚŏŋďƨƾ!ƒ ýŏƨǇǩ ƚŏǁďŽ ǇǇ ƠƴǍŏ 8 ý‡T!ƒ

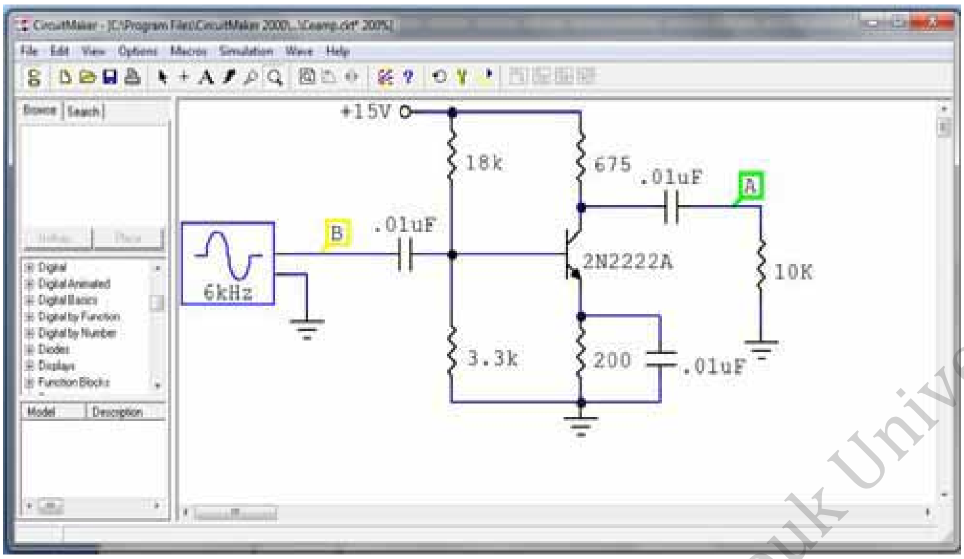
.Finish ǏǁŽ ƱƺƴƾĜƾ ƨďǩƪƒ



.ƚŏŋďƨƾ!ƒ ýŏƨǇǩ ƚŏǁďŽ ǅĜďǩƒ :8 ý‡T!ƒ

Ŏù5 ƚǇƨƤď lƨƑƒƥ ƨĜŏǩƤƪ ƴď Circuit Maker ƚŏŋďƨƾ!ƒ ƚnjŋƒǍ ƠƴǍŏ 9 ý‡T!ƒ -1

. ýĜǍď‡ ƚŏŋďƨƾ!ƒ ǇƦǈ



.ýĜƛdž ydž Ɨŏŋdžƨŀ!ƒ ƗnjŋƒĂ :9 ý‡T

:ƕĭďŇǰƀŧǁǁŰǫ Ɣƥǝǫǫǁǁǫ ƄƑďǴ

Ŧùŋŏķǉ!ƒ Ĭ!ǫ ýƮķ Ĭķơ Ŧǁ̊ƪǁ̊ƪķď ƘƒĂƱƤ ǁ ƪ5ǉ! ƴưķ ǇǊ Ɣŋŏ Ǵď ǀƧƑƒƥ ǇǴǉƕ ƥőƧķ ǴďƥǉƵ

:Őǁ̊ŏ Ǵď Ő5 ƘƒĂƱƤ!ƒ ǉŖǋ ƒ Ƥǁ̊ķķĂ Ŭǁ !Ŗ ǇǊď ǀĂŋƧď!ƒ

ǉŖùǋ ǇǴùǉƕ! Ŧďƨǚ!ƒ ƘǴǀǴƪơ!ƒ ǇƒƧŋǫ ƥƶƕ ŦƕƪǴǉď!ƒ ŦőǉĂƧķŧ!Ǘƒ ƘǴǉĂŧď!ƒĂ ƴƱǀ!ƒ ƧǴőķƤƒ - 1

.ǀƧƑƒƥ!ƒ

.Circuit Maker ǊďǴǉƧƕ ǅƒƥƤķƪǴƕ Ŧďďƫď!ƒ ǀƧƑƒƥǁ̊! ǜŖĂďǉ ǇǴǉƕ - 2

ǇǊďùư ǀƥĂùŋĂď!ƒ ƩǴǀ!ƒ ǀƨǌŋǅĂ ǀǴŧǴơď!ƒ ǅǴǓǉ ƪőƧƱ ǇƵ Ǵǋ ƧǴǉķƤƒĂ ǀƧƑƒƥ!ƒ ƒ ơ5 - 3

.ŦƕĂǁ̊Ʊď!ƒ ƘǴ5ƮƒĂď! ǴǀƕƱ Ǵǌǁ̊ďƵ ǇǊď ƥŧǟķ! ǊďǴǉƧƕ!ƒ

ƘƒĂùƱƤ!ƒ Ĭù!ǫ ǀƥĂƶ!ƒ ǅķķ ǛǊƑǴķǉ!ƒ Ő5 ĂǊ ǀƧƑƒƥ!ƒ ǉŖǋ ýőƺƮķ Ő5 ǟƱƤ ĭƒ ƻǴƮķŧƒ ƥǉƵ - 4

.ǴƱƤŰƒ Ơőơ ƮķĂ ǅőďƮķ!ƒ ýőƥƶķ! ŦǀǴƪ!ƒ

.ǴǌķǀƕǴƱď ǇǊď ƥŧǟķǁ̊! ŦőƧǓǉ!ƒ ǊƑǴķǉ!Ǵƕ ǴǌķǉƧǴǀďĂ ǊƑǴķǉ!ƒ ƒ ǚƤķƪƒ - 5

Ɣƥǝǫøǁǁǫ ƫ øƟƺǋ üĭŧƟŦǋ !ƨƥ ĂŧƳ ƕĭŧǅƳ ǀƑŝĭǴǓŦ Ǔǅ ƒƨƑƟǁǁƑǴ ƕĭďŇǰƀŧǁǁŰǫ ƥǝǫǋǫǁǁǫ !ĭǅƮŦ

ƕĭďŇǰƀŧǁǁŰǫ

ƨǴùǌŋ!ƒ Ĭ!ǫ Ǵǌǁ̊őďơķ Ŧő5őŧĂ Circuit Maker ŦőŋďƧƕ!ƒ Ƙƒƨőďď Ĭǁ̊Ƶ Ɣ!ǴƱ!ƒ ƻƧƶķ ƥƶƕ

ƴùď ǗǴùǌƕ ŦƮǴƤ!ƒ ƘƒĂƥŰƒ ŦƱƧƮǅĂ ŦőŋďƧƕ!ƒ ǉŖǋ ǅƒƥƤķƪƒ Ŧőőŧ Ĭ!ƒ ǇǗƒ ŝƧƱķ!ƒ ǅķő ƻĂƪ

.ǁ !Ŗ Ĭǁ̊Ƶ Ŧǁ̊ĂďŰƒ Ǔ'ƶƕ

.ƑǊƮƟƺǋ ƑǊŧĭŧƟŦǋ ƕƺŧƢǅǅǁǁǫ ƕĭďŇǰƀŧǁǁŰǫ Ɣƥǝǫǁǁǫ !ƨƥ ĂŧƳ Ɣƥǫƫǁǁǫ :ƒǋŧǓǅǁǁǫ

:ƕĭǝǫƥǜŰǫ ƹ ǫǫǉŰǫ

.Ŧǁ̊ƮķďƒĂ Ŧőďƥƨ!ƒ ŦőǉĂƧķŧ!Ǘƒ ƧƑƒĂƥ!ƒ ǅƪƧ Ɣ!ǴƱ!ƒ ǇǀķŏǇǊ - 1

.ǀƥƶķď!ƒ ƩǴǀ!ƒ ǀƨǌŋ ǅƒƥƤķƪƒ Ɣ!ǴƱ!ƒ ǇǀķŏǇǊ - 2

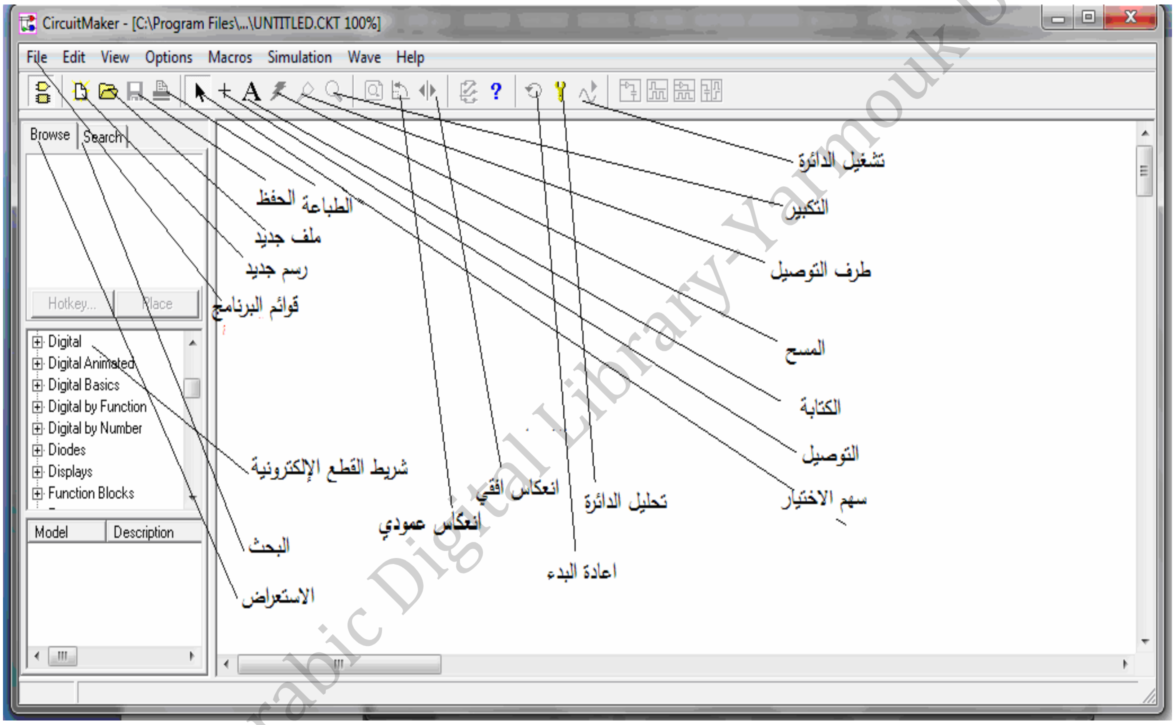
.ǀƿƶǆƾǌ!ƒ ƚǒǊȂƧǨǂ!Ǘƒ ƧƑƒǍƿ!ƒ ƒ ơǅȂ ýǒǉơǩ Ɣ!ǄƱ!ƒ ǇƖǊǩǒ ǇǍ -3

.ǀƿƶǆƾǌ!ƒ ƚǒǊȂƧǨǂ!Ǘƒ ƧƑƒǍƿ!ƒ ǊƦǋ Ǒ5 ýǄƱƵǗƒ ƟǔƮƒ Ɣ!ǄƱ!ƒ ǇƖǊǩǒ ǇǍ -4

!ǭƤǂ ƨ ǎƶǆ ƕǋǙǊǈ ǍǂƳ Ʃ ǁýǂƶ

ǂǊǒǀǌ!ƒ ǎǁƤǫƪǌ!ƒ ǂǋƞƒǍ ƨǋǙǪƪ Circuit MakerǋǌǈǊƨƕ ýǒƺǫǩ ǁǊƶ :ǎǁƤǫƪǌ!ƒ ǂǋƞƒǍ

.10 ýǂT!ƒ Ǒ5



ǎǁƤǫƪǌ!ƒ ǂǋƞƒǍ ǏǊƶ ƨ ƨƶǆ!ƒ :10 ýǂT

:ǑǫǗƒ ǇǌǊ ǎǁƤǫƪǌ!ƒ ǂǋƞƒǍ ǇǍǂǫǩ

- ǋǌǈǊƨƕ!ƒ ǎƑƒǍǉ
- .ƚǒǊȂƧǨǂ!Ǘƒ ýƱ!ƒ ƱǒƨT

.ǎƑƒǍ!ƒ ǊƦǋ! ƚǊǌǗƒ ýǌ ýƮ5ǌ ƟƨT ǑǊǒ ǌǉ Ǒ5Ǎ

:(**File**)

Circuit Maker (File) (New)

(Untitled) . 1

File 1 Save as

name Circuit Maker Ok .

Open 1

Print

:(Edit)

:(Select All) -

:(Delete)

:(Copy)

:(Cut)

:(Paste)

:(Circuit)

- :(Rotate) 90

- :(Flip Horizontal)

- :(Flip Vertical)

- :(Componet Properties)

- :(Zoom in)

- :(Zoom out)

- ýŏǁơƙ :lƧƒƒþ!ƒ ĈĈƱƵŬ ȠƑĜƙǉ!ƒ ĬǁƵ ŧơĂǁ!ƒ

- lþĜƵƒ :Ĉþƅ!ƒ lþĜƵŬ Ĉþƅ ýŏʒTƙ lƧƒƒþ!ƒ.

- ƱƧT ýƱl!ƒ :ŧŏǰĂƧƙŧ!Ǘƒ ǈƨƤǆ ǐĂơŏ ŧ5Ĝŧ ýƱl!ƒ.

- ŀơƅ!ƒ : ŀơƅ ǇƵ ŧƶƱl!ƒ ǇǆƶŧƅĂǁƱǆ!ƒ ǇǆƶýǖƤ ĜnjǆǷƧ Ăƒ ĜnjǆƪƒĜ.

- Ʊ ƒƧƶƙƪǗƒ : Ʊ ƒƧƶƙƪƒ ýƱlǁ! lþĂƞĂ!ƒ ǇǆƶýƞƒƧĜŏƙƤŬƒ.

:(**Analysis**) üǐŧƟŧǁƐ ƅƊžƏƑƽ

ƙơĂǐ ǉƦǋ ŧǆƶƑĜl!ƒ ĬǁƵ ƧǆƶƒĂǗƒ ŧƮĜƤ!ƒ ƙƅýŏʒT ĂƙơǁŏýƧƒƒĂþ!ƒ lþĂƞĂǆ!ƒ Ŏ5 ǉƦ5Ĝǉ ƧƒƒĂþ!ƒ.

:(**Window**) ƔƤʒƑǆǁƐ ƅƊžƏƑƽ

Ǉǆŧơƙǁ! ĜǆƶƅŏƶƵ Ʊ Ŏ5 lƦ5Ĝǉ Circuit Maker.

:þƏƐǋǭǁƐ Ʊǐþƪ

ƒǋǋ ƱŏƧT!ƒ lƧĜƅƵ ǇƵ ƒƧƨǈ ǇǆǂơŧƙǁƏ Ŏ5 lƧƒƒþ!ƒ. ýŏǆƞ ƧǆƶƒĂǗƒ ǉƦǈǆǆ!ƒ ĂƅƒƪƱŧ ǉƦǋ

ƧƒƧƨǗƒ ǆƶĂƞlþ Ʊ ǆƶǇ ƥþơǫ ǆƶƒƒĂl!ƒ ŧơĂƧTǆ!ƒ ƪĜǁƅǽ. ǆƶĜƅý ǁ!ǉ ǁƙŧƅŏƧǗ ƙ!ƮʒŏƧǗ ƱĜƅƵŧ.

ĂƙƤƨŏǇ.

:þƏƐǋǭǁƐ ƔƤʒƑǆ

Ŏ5 ǉƦǋ ǉƦ5Ĝǉ!ƒ ǇƙŏĈǉ lƧƒƒþ!ƒ þƒƧǆ!ƒ ǆƶơĜŧĜƙǈĜ.

: ʒ TǈǁǁƐ ƔƤʒƑǆ

ǋƝŎ ǉƦ5Ĝǉ ǆơŧl ǉƦ5Ĝǉƅ ƧƒƒĂþ!ƒ ĂǆƙŏǆƅþƒƤǁǈĜ ĂƮ 2 lƧƒƒþ!ƒ ƮǆǆŧǆƤǆ ǆƶǆʒ! ǆǆƵý lƧƒƒþ!ƒ ǉǆƵþ

ƒƧƞĂY ǆƶǈŏ!ƒ ŬơlĜ.

ƐŧƪǐüǁƐ: !ƅþĈ ƙʒŏý ĂǫŏlĜ 2 ƒǆǂơĜŧĜl.

Ư ƶ NǑ Ƶ ƽ ƱǇĂ ŰǍ Ư Ƨƶƙƪ NǇ ýƿĂ ÜƴƱ!ƒ ƱǒƧT ƥƤƙƪ !ƒ ƚƞƒĂ Ǉǆ Ĭ ŏ

.ƚ ƪ!ƒ ƧƒĂŰƒ

:ƚǒ!ƙ!ƒ ƘƒĂƱƤ!ƒ yƙƒ :üƒƙƊ

1. ýƺT ƝƧ Circuit Maker.

2. ƠƙƒƤƒ ƧƒƤ ƚƨƤ Ǒ ƚǒƞƧ!ƒ ǓƱƺư! Ĭ!Ƶ ƧƨƧ!ƒ C >

Files Programs> 2000 Circuit Maker >

Examples >Circuits.

3. ǇŰƒ ƙƤ ýǒƺTƙ!ƒ ǇƵ ƽǒƧƱ ƟǍƙ ýǒƺTƙ!ƒ ƥƙ! lƧƒƤ!ƒ ýƶ!.

4. ǇŰƒ ƚƧƞƙ ƙƤ ƧƒĂŰƒ ǑƙƵ ƧƵ ư Ĭ!ǫ ǇŰƒ.

:ƲƯƽ Ưĭƥƪ

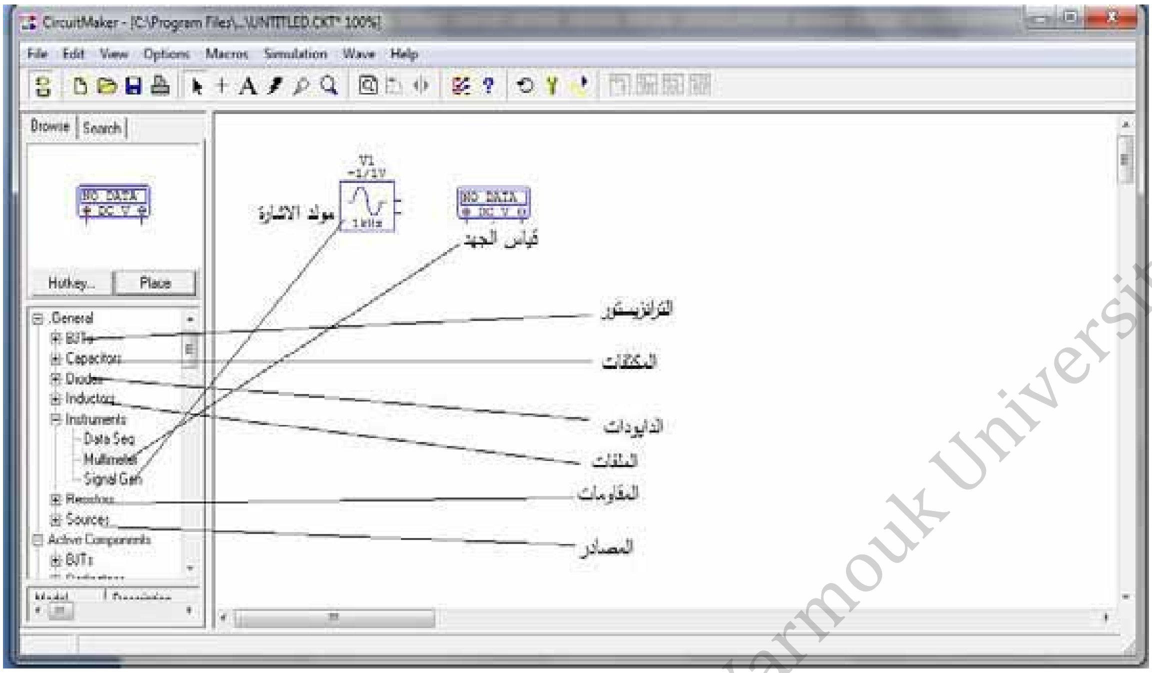
ƙƥǒ ƤƙƒƧƞ yƙ!ƒ ýƞ ƙƒƚƞ ƩƧ!ƒ ƽǒƧƱ ǇƵ ƱǒƧT!ƒ. ĂǇĂ lƧƵ ǇƵ lƤƵ ƚƱƧTƊ ǂ

:Ǒ!ƙ!ƒ ǇǆƠ ư ƙǒƪ

1. Ưĭƥƪ ƥƒƑT (Sources): ĂƙƠǒĂ ĭ Ĭ Ƶ ƤƵ ƳƒĂ ǇǆƚƢ ƚƱ!ƒ ƙƒǔƧ ƘƒƤƤƧ

ýǆƚ: ƚƤ ƚǑƙƠ ƚƤ ƚƙƪ ÜƤƤƧ ĂƺƧ ƫ!Ʀ ǇǆƚƢ!ƒ Ƨ ƚ ǂ ǍǆǇ ǇǑƙ!T ƚ

:11



ýǂT :11 ŁƱƧTƒ ƧþƓŢdž!ƒ ýƱ!ƒĂ

2. ŲĩþĬ ŲŬǁŲǕƐ ƨƒƩƐħ :(**Basics**) ýdžǨTŏ ƒŖǋ ƱǒƧT!ƒ ĬĩƵ ýƱ!ƒ ŰǕĬŲƓĬǕƒ ŁǜĬŁǖdž!ƒ

.ŁǒǈĂƧǨǂ!ƒý ýƱ!ƒ ǇdžŲǈƧǒƹĂ ƘƓƼǁdž!ƒ ǕƘƓǂǂdž!ƒ ǕƘƓdžĂƓǁdž!ƒ ýǁdž ƧƑƒĂþ!ƒ ǉǕƶdž!

3. ƐƧƵDŽTǈ! ǏƟƒdžƘǁ (**Diodes**): ǇƵ ƧƱǒƮ ƒŖǋ ŲĩþĬ ǈŏǉ ƧƓǒƘǉ ĂþþƠƘĂ ǂƓƼŢƒĂdž

ƒǈƓǈǃ!ƒ (Diode) ĂǈǂƧdž ƧƓǒƘǉ ƒǈƓǈǃ!ƒ Ǒ!ƓǂdžǕƒ (ideal diode) ǙĂ ǈƧƓǒŲŷ ƧǉƧ!ƓŲ ǈŲĬƒĂ

.ƒ!ƧǂŁ

ǉƓĬŢý ǇƵ ǈƓƼǈ!ƒ ŁǒǈƓ!ƓƐ ƧǈƓǈǈƧdž ǇƵ ǈƓǈǃ!ƒ (Diode).

4. ŲĩþĬ ǏǂǕ :(**Transistors**) ýǁdž ƱǒƧT!ƒ ƓƐǉ!ƒ.

5. ŲĩþĬ ǀǂǕǙǆ : ǕĂƓƵǒǉĂ ǇƵ ǆƒǉ ýƒǉƓĬ !ƘƵƒ ƒ ǉƓǈǒƓǂƒ .ŁǒǈƓǈǈ!ƒ ǉƓǈǈ ŁƓǂƓ ƧƒĬŲǈ

(Ammeter) ƧƐƓǁǈ!ƒ ƩƓǈƓǈǈĂ (Voltmeter) ƐǉǈǈǈǈǕ ƩƓǈǈǈĂ (Oscilloscope) ǉƧƓƘƓƒ

.ƓǈǈƧǒƹĂ

6. ŲĩþĬ ǈƓǈƼǁ :ǈǈǈǈǈ ǈǈ ǇƓǈƒ ƩƓǈǈ ǈǈǈǈǈ ǈǈǈ ǕǈǈǈǈǈǈƓǉ ǈǈǈǈǈǈǈ ǈǈǈǈǈ

Circuit Maker ǕǈǕ ǈǈǈǈ ǈǈǈ ǈǈǈǈǈǈ ǈǈǈǈǈ ǈǈǈ ǈǈǈǈǈǈ ǈǈǈǈǈǈ ǈǈǈǈǈǈ.

:ƓŭďǈǋǐŧǁǁǛǫ ǗǐǝǫǠǁǫ ƅǭďǴ Ɩ ǫǋǛǕǟ

ǴùďǏ Ǥƪơ ǴǌǨďǒǑ ƧǒǒƷǨ ǇďǏ ƖƧǭǬǐ!ǬǬ ƇǴǈǚ! ǁǈďǏ ŧǚǍǁƱďǏ!Ǭ ŧǒǈǍƧǨŧ!ǗǬ Ƨ Ʈ ǴǈƶǏ!Ǭ ǇǒďǏƞ ǤơƪǬ -1

. ǁǒ!ǫ ǏƱƶďǏ ǍǋǊ

.ƖƧǭǬǐǁ! ǐ ƧƱǈ!Ǭ ǉŧƬ!Ǭ ǴǈǍŧďǏ Ƨ Ʈ ǴǈƶǏ!Ǭ ƽǒƪǈǨǚ ǊǏ -2

.ƘǛ5ǗǬǍ ǤơƪǬ!Ǭ ǤǍǁƪǚ ƯƶǚǬ!Ǭ ǴǌƿƶǚǏǇďǏ Ƨ Ʈ ǴǈƶǏ!Ǭ ǉǒ Ʈ ǍǨǚ ǊǏ -3

ǈȒùǋ ƘǈǍŧ ƇǬǍƪ ǴǌǨďǏǛƪ ǇǍďǏ ǐŧǍǨ!ǬǍ ƖƧǭǬǐ!Ǭ ƒ ơƽ! ŧǚǍǁƱďǏ!Ǭ ƩǴǒǇ!Ǭ Ɩƨǌǈƞ ǉǒ Ʈ ǍǨǚ ǊǏ -4

.(ƖƨǌǈƞǗǬ ǇǍďǏ ǴǋƧǒƸ ǍǊ ǐǌǈƞ!Ǭ ƩǴǒǇďǏ ǍǊ ƖƧǴƬǗǬ ǏƪǬƧ ƨǴǌǈƞ) ƖƨǌǈƞǗǬ

ǐǝǫǋǠǁǫ ƫ ƟƷǋ ƅǭďǴ

:ǑǁǴǨ!Ǭ ǏǁƵ ƻƧƶǨǈƪ ƧǭǍǐ!Ǭ ǈȒǋ ƇǴǈǚ ǉǛƤ ǇǍďǏǍ ǺǒǬǐǚ

• ƘǴǈǍŧďǏ!Ǭ ǇƯǍǍ ƧǴǒǨƤǬ

• ƘǴǈǍŧďǏ!Ǭ ǉǒ ƮǍǨ

• ƘǴǈǍŧďǏ!Ǭ ŧǒďǏƪǨ

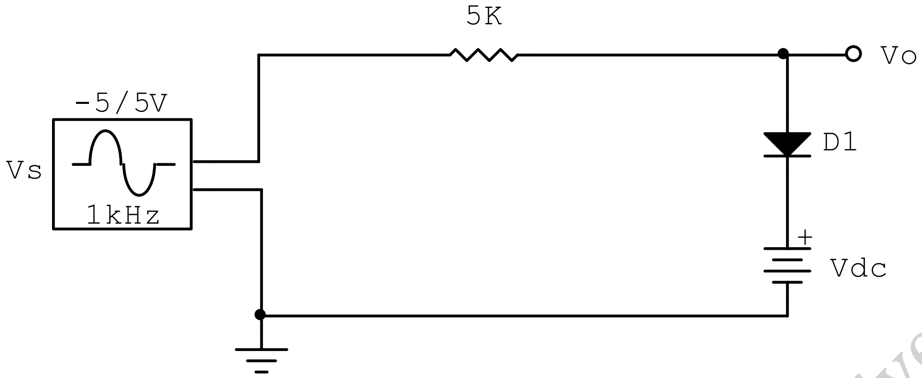
• .ŧǒǁǍǴďǏǨ!Ǭ ƩǴǒǇ!Ǭ Ɩƨǌǈƞ Ưƶǚ ǊǬǐƤǨƪǬ

ǏǨơ ǛƮ5ďǏ ǇǍŧǒƪ ǉǍǗǬ ǉǴǍďǏ!Ǭ ǕŧǁǍďǏǗǬ ŧƱƪǬǍǚ ƖƧǭǬǐ!Ǭ ƇǴǈǚ ƘǬǍƱƤ! ƟƧƬ ǑǁǒǴďǏ Ǒ5Ǎ

ƟƧùƬ ǏùǁƵ ƨǒŧƧǨ!Ǭ ǇǍŧǒƪǍ ƖƧƮǨƤďǏ ǇǍŧǨƪ ŧǁơǛ!Ǭ ŧǁǍďǏǗǬǍ ŧǐǐǒ ƧďǏǬǍǗǬ ŧ5ƧƶďǏ ǇǍďǏ ǇŧďǏǨǈ

.ǉǍǗǬ ǉǴǍďǏ!ǴǚǊǐǚǈ! ǇǗǬǍ ŧǒ5ǴƯǗǬ ƘǬƨǒďǏďǏ!Ǭ Ưƶǚ

:12ǉŧƬ!Ǭ Ǒ5 ǴďǏŧ ǐǍǁƵ ƒ ǒ ƖƧǭǐ ƇǴǈǚ :1 ǉǴǍďǏ



ĭ ĂǁƵ ƒ ɒ lƧƑƒƥ :12ý‡T

.Circuit Maker ŧƱƪƒĂh lƧƑƒƥ!ƒ ljŘNj ýǒʎdžƙh DžĂlLj! LJǕƒĂ

:ƔƥəɛƍǁǁƐ ƃƑdžĜǁ hDžŘǘǁƐ l ƑdžNjlDžǁƐ ƥƑĭŧƢƺ :ƒĭdžÐƙ

:(hĭƥƑƲĜǁƐ) ƍNJШǁƐ ƥƍTDž

.ŧǒƧĜƱh!ƒ ƨdžƨ ĬǁƵ DžĂ LJdžĂ ƧƥĜƮdž!ƒ ƱǒƧT ĬǁƵ lƧƌ!ƒ ŧƱƪƒĂh ƧlLj!Ĝh

: l ƑDŽNjƑʂDžǁƐ

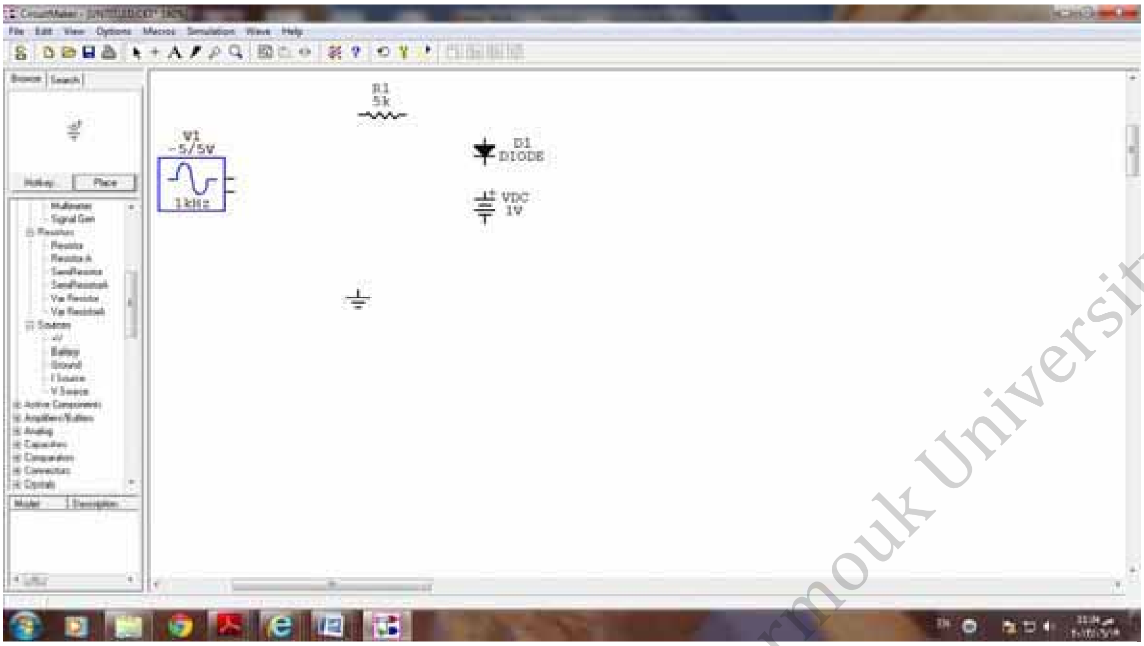
Σ5LjùhƧƑƒĂƥù!ƒ lŖ5ĜLj ýƤƒƥ ĜnjƵư Ă DžƙǒĂ ŧǒƪĜƪǕƒ ƴƱl!ƒ ƱǒƧT LJdž ƘĜdžĂĜldž!ƒ ƧĜǒƙƤƪ Džƙǒ

.ŧlhĜƪ!ƒ lĂƱƤ!ƒ Ŏ5 ŧǒƧĜƱh!ƒ Ĝnjh ƘƵư Ă Ŏƙ!ƒ ŧlǒƧƱ!ƒ

: ƒ ĭƥÐŧǁƐ

ƘƒĂƱƤ!ƒ ʂǒhƱƙ ƥƵh .ƧƑƒĂƥ!ƒ lŖ5ĜLj ýƤƒƥ ƴư ĂǒĂ ƧƥĜƮdž!ƒ ƱǒƧT LJdž Ŏư ƧǕƒ ƧĜǒƙƤƪ Džƙǒ

.LJDƧĂƥ!ƒĂ ǁǒƧơƙ!ƒ ƥƵh ƴƱl!ƒ ƔǒƙƧƙ LJǒhǒ ĭŖ!ƒ 12 ý‡T!ƒ Ŏ5 Ĝdž‡ ƧƑƒĂƥ!ƒ lŖ5ĜLj ƧnjƱƙ ŧlhĜƪ!ƒ



ǈǊƧĂþ!ƒĂ ‖ŏƧơǩ!ƒ þƶƅ ƴƱ!ƒ Ɣŏǩ Ƨǩ :12 ý‡T

:ǀ ƑǆǈǉǆǇ ƕǆǇ ƨ‡ :ƒƴǄþ

ǨǄǉĂ‡ǆ ƴŏǆƞ ǈǊ ‡ŏơ Ǆǈǃ ‡ƶƱ!ƒ ǏǇƸ Ƨǀǉǆ ‡ǆþƤǩǀǆ!ƒ ƴƱ!ƒ ǈŏþ ƧǄŏǩƤƒ

ǨŭƬĂǆ!ƒ ĂǊ ƴƱ!ƒ ‡ŏǆǀǩ ǈǩǩ .‡ŏǆǀǩ! ‡ǆǃþ ǨŭƬĂǆ ĂǊ ‡ŏǉĂƧǩ‡!ƍ ƴƱþ ǈǆ ǀƧƑƒþ!ƒ

:Ŏ!Ǆǩ!Ǆ‡

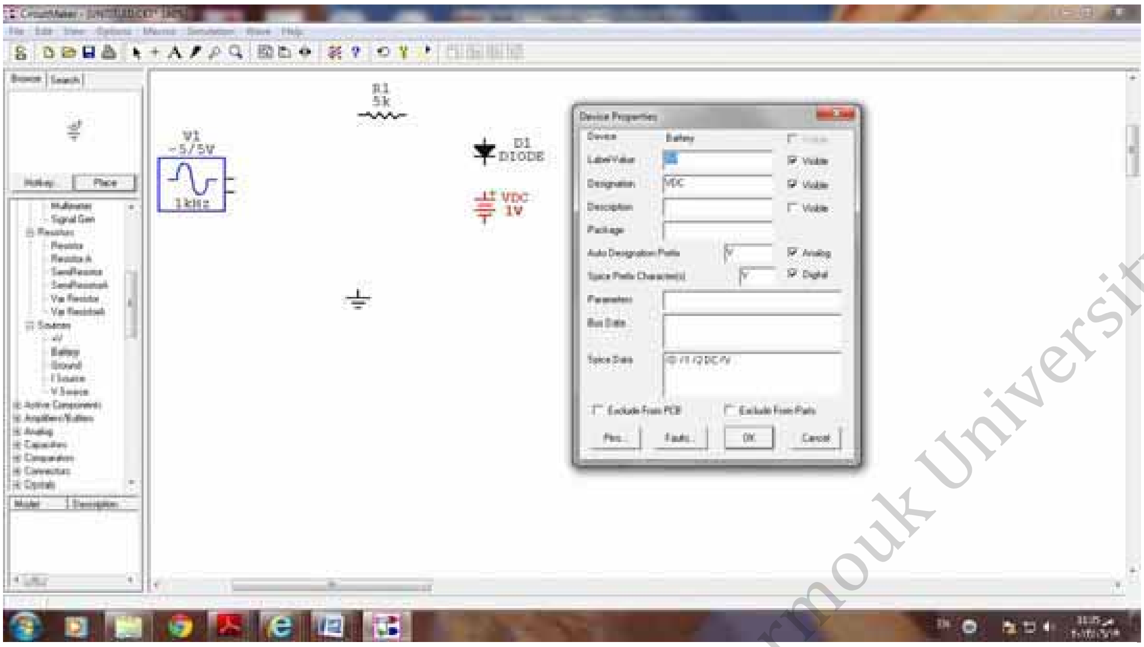
- .Ǆǉǩŏǆǀǩ þƒƧǆ!ƒ ‡ƶƱ!ƒ ǏǇƸ ǈŏǩƧǆ ƧǇǈ

- .ǈŏǇ!ƒ ǉǈǉ ǄƼƤƒ Ăƒ ƧǄǉƱƒ ƴǆ ‡ƶƱǇ! ǈǀŮƒĂ ‡ǆŏǇ!ƒ ƧŏŏƷǩ

ǨǈùƤǊ ǊǈĂǆ ‡ǆĂǄǇǆ!Ǆ5 ǕǀþþơǨ ‡ǆŏþ ǨƒǨ ǈǊĂ‡ǩ ǨǄǉĂ‡ǆ!ƒ ƧǄŏǩƤƒ þƧƞǆǅĂ ǉǈǊ Ʊơŭǩ ƨĂǀ

ăƧǩ Ǆǆ‡ Ƨŏŏƶǩǀ! ‡ǆǃǄþ ŎǉǉĂ ‡ŏ!ĂŮƒ ǈŏǇ!ƒ Ǆǉŏǈƶ ƾǈƱŏ ǈŏǇ!ƒ ǉǈǉ .10V ‡þǄƱ!ƒ Ƨþ ƬǆĂ Ǖ1K ‡ǆŏþ

.13 ý‡T!ƒ Ŏ5


R1
5k
V1
-5/5V
1kHz
D1
DIODE
VDC
1V
Device Properties
Parameters
Exclude From PCB
Exclude From Parts
OK
Cancel

[illegible] :13 [illegible]

[illegible]:

[illegible]

[illegible]

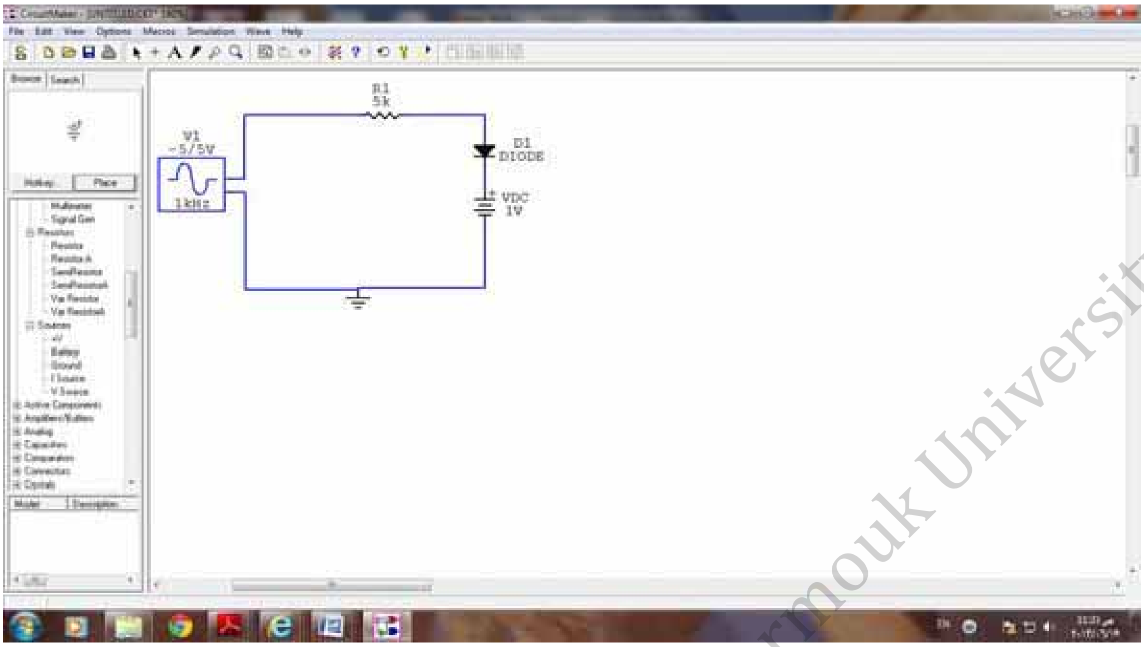
[illegible]

[illegible].

[illegible]:

[illegible]

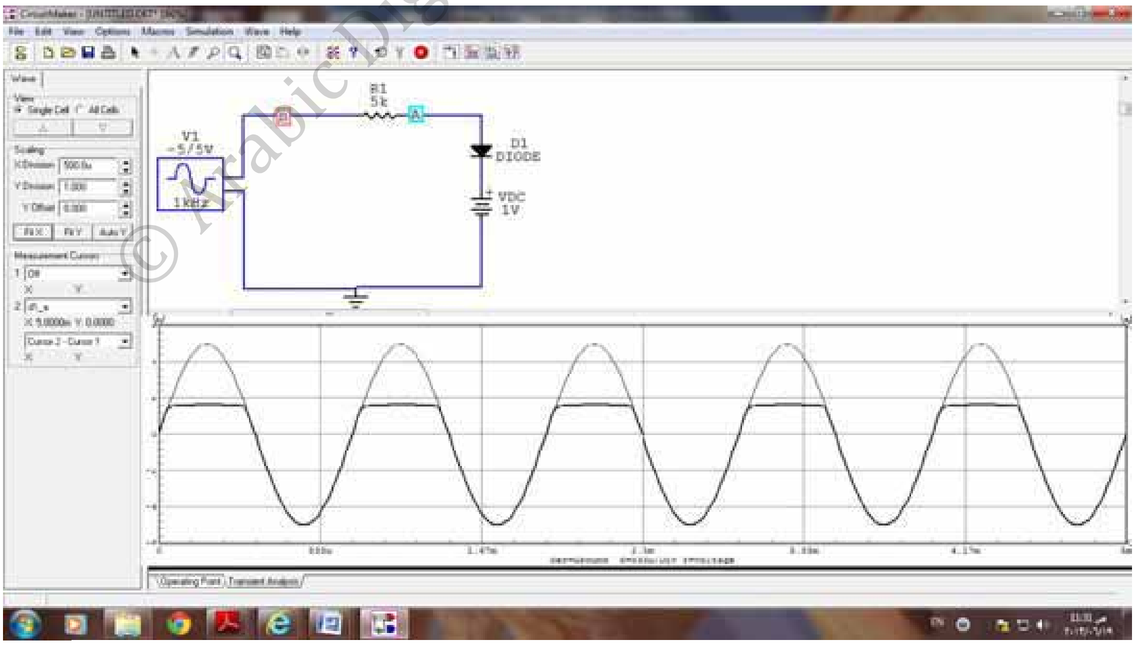
:14 [illegible]



ÿƠl!ƒ LJŏŀ ýŏŢ Ăķ!ƒ :14 ýǂT

:Circuit Maker üǐƸƪǂ

:15 ül ƪǁǁ Ĭƺ ƒDŽl ÿþƏƐǁǁ ĂǂY ŀUŚŀ DŽDŽ þķlƐ Ĭƺ ƛƏƑǂǁǁ þƑNJuƐNj ÿþƏƐǁǁ üǐƸƪǂ



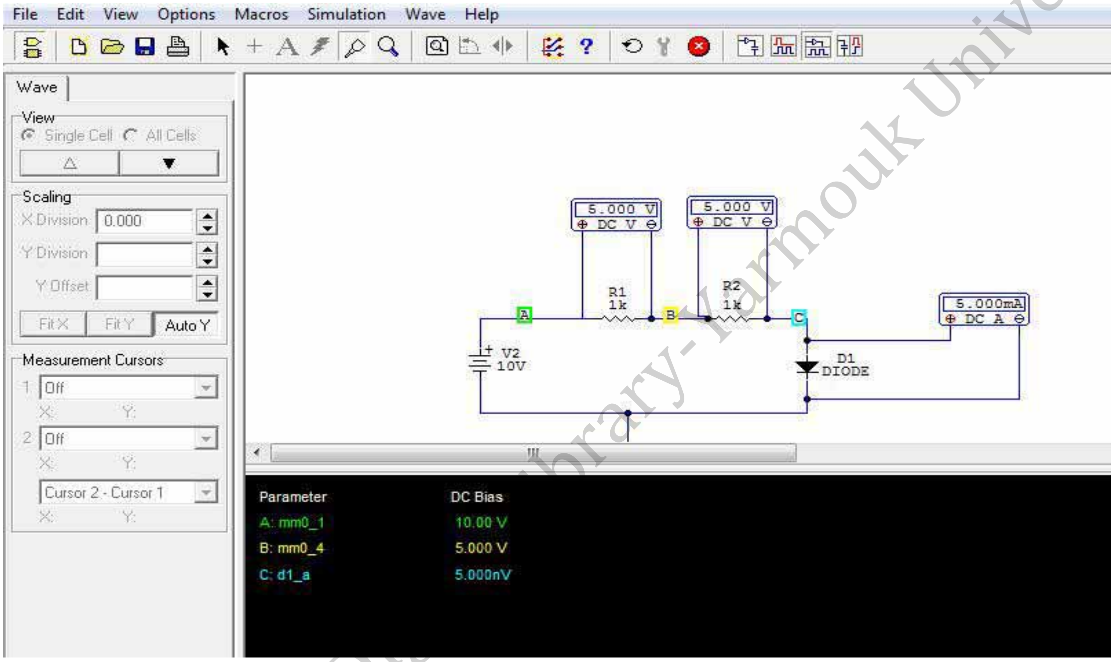
NƑĜķǉ!ƒ ƧĜnjUƒĂ lƧƒƒþ!ƒ ýŏƺTķ :15 ýǂT

DžĩþFDžŧIJĘ

:ơNjĩĘơǁĘ hŭTFǪ] 5ĭĜŪŧNj !Njc DžNjďF5 5ĭĜŪŧ ỵþƏĘơ :üNjŬĘ DžĩþDžŧIJĘ

Ǒù5 ŧõ!Ĝk!f Džõl!f ɣʅơƉ ΣĜõl!f lƨnjɳŰ ǁkĈfƧp ýŭP LJdž Ü16 ý‡T!f Ǒ5 lƧffþ!f ĈĜljhh Džp

.1 ýĂþɳ!f



þĂõfþ!f ŧõŢĜPĂ DžĂD LJĂljĜp ʂõlơk lƧffþ :16 ý‡T!f

.ƘĜdžĂĜldžĭ! ŧ5ĭkPdž Džõp þljZ þnjɳ!f Džõp :1 ýĂþɳ

R1	1K	1K	2K	5K	1K	1K	4K	1K	6K
R2	1K	2K	1K	2K	5K	8K	6K	1K	4K
V_{R1}	…….	…….	…….	…….	…….	…….	…….	…….	…….
V_{R2}	…….	…….	…….	…….	…….	…….	…….	…….	…….
……………………. ŧpŭZ ƧĜõk!fĂ ŧdžĂĜldž!f LJõh ŧpŭz!f									

þùǉƵ ǸùǩǒǨ!Ă5 ŧùǆǒpĂ þĂǒƒþ!ƒ Ŏ5 ƨǤǆ!ƒ ƨǤǒǨ!ƒ ŧǆǒp þŋĂǛ 1K þǉƵ ƘǤǆĂǤǆ!ƒ ƘĂǜ þǉƵ -

ƨǒǒǒʒǩ

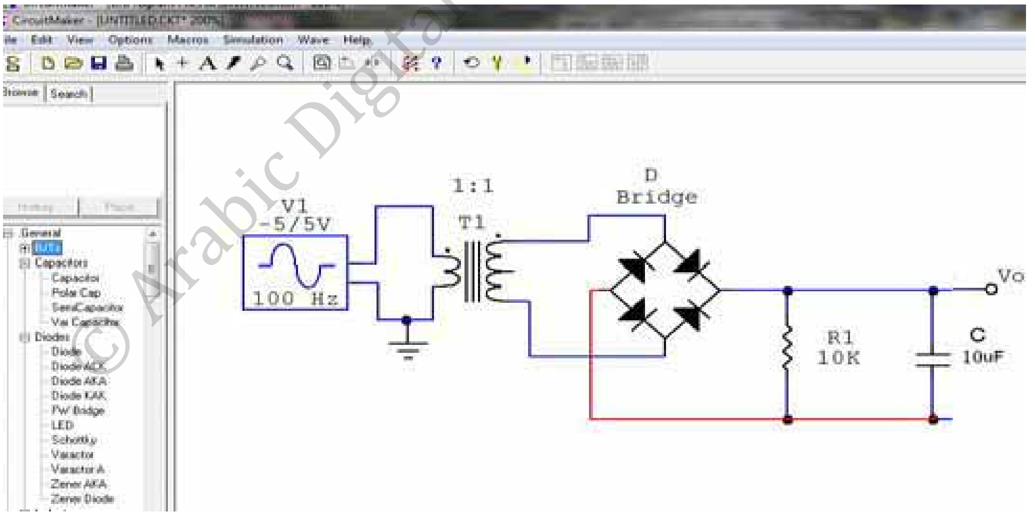
:2 ýĂþŋ!ƒ Ŏ5 ŧǒ!ǤǨ!ƒ þnjŋ!ƒ Ǆǒp

þnjŋǃ! ŧ5ǃǨPǆ Ǆǒp þǉƵ þĂǒƒþǃ! ƨǤǒǨ!ƒĂ þnjŋ!ƒ Ǆǒp :2 ýĂþŋ

V2=	1V	1.5V	2	2.5V	3V	3.5V	4V	4.5V	5V
I_D	…….	…….	…….	…….	…….	…….	…….	…….	…….
V_D	…….	…….	…….	…….	…….	…….	…….	…….	…….
.(Ǆʅƨƒ) ……………………… ŧpŭƵ Ǹǚ ƨǤǆ!ƒ ƨǤǒǨ!ƒĂ þĂǒƒþ!ƒ þnjŋ Ǉǒǚ ŧpŭz!ƒ									

.ɩƨƱǉǀ!ƒ ǄƒþPǨʅǤǚ ŧŋĂǆ!ƒ ýǆǤǂ ǄǒĂǀǨ ɩƨƑƒþ :ŎǉǤǃ!ƒ ǇǒƨǆǨ!ƒ

:Ŏǃǒ Ǥǆ ȐǉĂ ŧǒ!ǤǨ!ƒ ɩƨƑƒþ!ƒ ǤǤǉǚǚ Ǆp



ɩƨƱǉǀ!ƒ ǄƒþPǨʅǤǚ ŧŋĂǆ!ƒ ýǆǤǂ ǄǒĂǀǨ ɩƨƑƒþ :17 ýǂT

.ǄǒĂǀǨ!ƒ ɩƨƑƒþ! ýPþǆ!ƒ ɩƨǤTƒĂ ɰƨPǆ!ƒ ɩƨǤTƒ Ǉǆ ŭǂ ƨnjUƒĂ ɩƨǤTŬƒ Ǆʅƒƨ ƨǤnjŋ ýȚ -1

Ǆùʅƨƒ Ă 400uF Ü100uF Ü10uF Ĭù!ȷ ɰƨPǆ!ƒ ĬǃƵ ýĂȚĂǆ!ƒ C ƻǂǂǆ!ƒ Ǆǒp ƨǒƸ -2

.ǤǆƨʅƼĂ ɰƨPǆ!ƒ ɩƨǤTǛ

ýù‡! ШƧùƤďž!ƒ ϸnjŋ ǏǈŹ ýĂŢơǈ! ΝƱƕ ưƒĂ ϒƪǤǉdž!ƒ ǈǻ‡dž!ƒ Ŏ5 ƧǩǒdžǨ!Ă5!ƒ ƨǤnjŋ ýŢ -3

.Ƨ λ‡dž!ƒ Džǒp LJdž Ɨdžǒp

.Ƨ λ‡dž!ƒ Džǒp LJdž Ɨdžǒp ý‡! ШĂdžǨ!ƒ Ɨƕƪǉ ΣǤǒlƕ Džp -4

.ǤNjƧǒƪ5ǨĂ ǤnjƪǤǒlƕ DžpĂ ШƧƤdž!ƒ ƖƧǤƬD DžƪƧƒĂ Ƨ λ‡dž!ƒ ýŢ5ƒ -5

- ϸnjŋ ШƧƤdž!ƒ (Ɨdžp-ȿdžp):...........................

- ϸnjŋ!ƒ ƘƕǤǨ!ƒ ШƧƤdžǈ!:...........................

ƘǤ5λ‡dž!ƒ Ɨƺƪ ƧǒƺǨ ϸǉŹ ƘǤƱơǔdž!ƒ

....

....

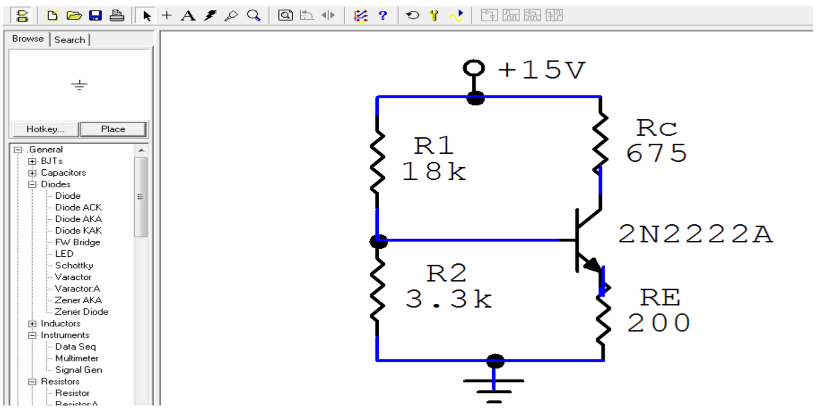
Ƨ λ‡dž!ƒ ýŢ5 ϸǉŹ ƘǤƱơǔdž!ƒ

....

....

ƧĂǨƪǒƨǉƒƧǨ!ƒ ǏǈŹ ϸnjŋ!ƒ Džǒƪlk ƖƧƒϸ : ‡ !ǤλƒLJǒƧdžǨ!ƒ

:Ŏǈǒ Ǥdž ƦǉǉĂ Ɨǒ!ǤǨ!ƒ ƖƧƒϸ!ƒ ǄǤǉƕƕ Džp



ƧĂǨƪǒƨǉƒƧǨ!ƒ ǏǈŹ ϸnjŋ!ƒ Džǒƪlk ƖƧƒϸ :18 ý‡T

:3 ýĂþŋ!ƒ Ŏ5 Ɨŏ!Ǵķ!ƒ ƱǴǀǉ!ƒ þǉƵ þǌŋ!ƒ Ǖŏp ΣǴŏǀǃ Ǖp -1

ƧĂķʅŏƨǉƒƧķǁ! Ɨ5ǁķƤǆ ƱǴǀǉ! þǌŋ!ƒ Ǖŏp :3 ýĂþŋ

ợǊǕǁǁǀ Ɨǆǒǐ	ƱǴǀǉ!ƒ
	V_B
	V_E
	V_C
	V_{CEQ}
	V_{BEQ}

ƒŘǴùǆ .lƧùǆ ý‡ Ŏ5 ǁķƒÇƒƧp ýŋʅĂ ýpƌ5 ýpƒ Ǖŏǀǃ R2 ǉƧŏʓķǆ!ƒ ƗǆĂǴǀǆ!ƒ Ɨǆŏp Ŏ5 Ƨŏƹ -2

ÞƱơǚķ

ÞƱơǚķ ƒŘǴǆ .ǁķƒÇƒƧp ýŋʅĂ lƧǆ ý‡ Ŏ5 **V_{BEQ}** ΣǴŏǀǃ ǕpĂ ƘǴǆĂǴǀǆ!ƒ Ǖŏp Ŏ5 Ƨŏƹ -3

:lƧƒƒþ!ƒ ĬǁƵ ƘǴƱơǚǆ!ƒ

………………………………………………………………………………

………………………………………………………………………………

Abstract

AL-Howari, Omar Ali, The Effect of Virtual Lab in Acquiring Engineering Concepts, Critical Thinking Skills and Practical Skills of the Electronic Engineering Students at Yarmouk University

Ph. D. Dissertation, Yarmouk University. (Supervisor: Professor Ghazi Rawagah)

This study aimed to investigate the effect of the virtual lab in acquiring engineering concepts, critical thinking skills and practical skills of the electronic engineering students at Yarmouk University

The sample consisted of (88) students divided into four classes from electronics engineering lab (1) (males and females), and for two specializations: A (Electronics and Communications), and B (Power, Computer and Medical). Students were divided randomly into two groups: The experimental group with (44) students which were taught by using virtual lab method with an educational software program called (Circuit Maker), and the control group with (44) students and were taught by using the ordinary method. To achieve objectives of this study the researcher set up the following tools: A test for acquiring engineering concepts, a test for acquiring critical thinking, and a note card for acquiring practical skills of electronic engineering in a Virtual Lab method. The authenticity of the study tools was verified and they were applied before and after the on both groups.

The results were as follows:There were significant statistical differences at (α= 0.05) between the means of participants responses on acquiring engineering concepts post test attributed to the impact of the (Virtual Lab), and to the specialization of A (Electronics and Communications), and to the interaction between the metod and specialization. It was also showed no statistically significant differences attributable to the effect of each: gender , and interaction between method and gender, gender and specialization, and the third interaction between method, gender and specialization.

Moreover for the critical thinking skills, this study showed significant statistical differences at (α= 0.05) between the means of participants responses of attributed to the impact of the (Virtual Lab). The study also showed no statistically significant differences attributable to the impact of both gender and specialization, and no interaction between: method and gender, method and specialization, gender and specialization and the third interaction between the method, gender and specialization

In addition, the study showed significant statistical differences at (α= 0.05) between the means of participants responses of practical skills, posttest attributed to the impact of the (Virtual Laboratory). The study also showed no statistically significant differences attributed to both gender and specialization, and the interaction between each of the method and gender, method and specialization, gender and specialization and also to the impact of the third interaction between the method, gender and specialization

Depending on the results of this study, and in order to solve the problems faced by labs of Engineering Faculty at Yarmouk University, researcher has recommended to teach the electronics engineering lab (1) using the Virtual Labs for the integration of modern technological methods, and to rise the level in acquirng the Engineering concepts, Critical thinking skills and Practical skills, and also expands Virtual Labs in the field of Electronics Engineering lab education, and make these labs fundamental in teaching. In addition, it recommended to take the advantagea of the software used in this study (Circuit Maker) by the teachers specialized in this field, and to encourage students to use it because it has proved its effectiveness. Also reasearcher recommended to do other similar studies to demonstrate the impact of effectiveness of virtual laboratories on other electronics engineering labs.

Key Words: Virtual Labs, Simulation Programming, Educational Software, Engineering Concepts, Critical Thinking Skills, Practical Engineering Skills, Electronics Engineering Students.